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NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

ON-LINE REAL-TIME MANAGEMENT INFORMATION SYSTEMS AND THEIR IMPACT UPON USER PERSONNEL AND ORGANIZATIONAL STRUCTURE IN AVIATION MAINTENANCE ACTIVITIES

by

Benjamin A. Bayma, Jr.
Lieutenant, United States Navy

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A085111	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) ON-LINE REAL-TIME MANAGEMENT INFORMATION SYSTEMS AND THEIR IMPACT UPON USER PERSONNEL AND ORGANIZATIONAL STRUCTURE IN AVIATION MAINTENANCE ACTIVITIES		5. TYPE OF REPORT & PERIOD COVERED Master's Thesis December 1979
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Benjamin A. Bayma, Jr.		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Postgraduate School Monterey, California 93940		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Postgraduate School Monterey, California 93940		12. REPORT DATE December 1979
		13. NUMBER OF PAGES 94
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Management Information Systems, Technological Innovation, MIS, On-line Real-time computer systems, Technological impact, Organizational structure.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The introduction of a new technology into an organization can significantly impact the organization's effectiveness. Some possible effects on user personnel and organizational structure during and after the implementation of an on-line real-time computer-based management information system are explored in this thesis. The organizational structure and Management Information Service (MIS) users within aviation maintenance activities are identified. The possible impact on the informal and formal decision-making structures within these activities is predicted using a contingency model. Possible implementation strategies to minimize that impact and maximize the probability of MIS implementation success are investigated. The

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(Page 1) S/N 0102-014-6601

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Benjamin A. Bayma, Jr.
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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

From the
NAVAL POSTGRADUATE SCHOOL
December 1979

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I. INTRODUCTION

Successful implementation of a Management Information System (MIS) depends on many complicated and complex issues. Gibson (1977) underscores the key issue for successful information development and implementation. Simply stated, it is the need for user involvement. He emphasizes, however, that user involvement is sometimes difficult to achieve. Wagner (1972), a manager for Peat, Marwick, Mitchell, & Co., stated that "Considering the many ingredients which comprise a management information system, and being asked to quantify and list those ingredients in order of importance," he would place user involvement very near the top of the list, if not at the top.

Many information systems, according to Lucas (1978, p.59) have failed because the reactions of the users were ignored or because the designers did not consider the impact of the system on the organization. He further states that no matter how a system is technically elegant, the system is successful only if it is used. Lucas concludes with the warning that organizational factors are as important (or more so) as the technological considerations in operating or designing a computer-based management information system.

The functional description of the Naval Aviation Logistics Command Management Information System (NALCOMIS Module I) states that no major organizational impacts are anticipated when it is implemented into the Naval Aviation 3-M system. NALCOMIS, being a state-of-the art, high technology, on-line real-time computer-based management information system is, in fact, a technological change which will be installed in organizations made up of people. Taylor (1971, p. 12) shows evidence that technology can affect organizational structure, behavior, productivity, and attitudes of user personnel. The issue of the impact on users and organizational structure of NALCOMIS has not received the managerial attention that the literature would indicate it deserves. This thesis will attempt to remedy this deficiency and assist the NALCOMIS Project Manager at the Fleet Material Support Office in his responsibilities.

A. OBJECTIVE

The concept of on-line real-time management information systems and their impact on user personnel and organizational structure in aviation maintenance activities will be explored. This concept is broad in management and organizational relationships and will deliberately avoid, to the maximum extent possible, the more technical aspects of computer utilizations, computer system development, and software design.

The positive and negative impact on users and organizational structure will be discussed, as well as the issue of implementation of the on-line real-time management information system. The Naval Aviation Logistics Command Management Information System (NALCOMIS) will be addressed in this study as the vehicle to convey the typical resultant impact on user personnel and the structure of aviation maintenance support activities.

Information will be provided concerning the background, purposes, and problems associated with combining real-time on-line computer systems, management information systems, and users. Comparisons will be made with other MIS systems which have met with varying degrees of success within the U.S. Navy and U.S. Marine Corps aviation maintenance community. The objective is to provide the reader with sufficient data on which to draw an informative conclusion concerning the issues facing a project manager as he implements an On-Line Real-Time Management Information System (OLRT MIS) in an organization. The volume of material available and the limited scope of this study precludes an in-depth analysis of the entire Naval Aviation Maintenance (NAMP) and how it will be affected by NALCOMIS and OLRT MIS. NALCOMIS MODULE I and its resultant impact on the Intermediate Maintenance Activity (IMA), the organizational maintenance activity (OMA), and the Supply Support Center (SSC) will be the limited conclusion areas of concern in this thesis.

The major conclusion is that all too often during implementation and operation of OLRT MIS systems, too much attention has been directed to the technical aspects of computers and data processing and too little attention given to the user personnel's reactions and responses to the OLRT systems or to the impact on the organizational structure in which the user operates.

This study, accordingly, was motivated not only by an interest in the impact of an OLRT MIS, but also by what effect awareness and managerial action, especially by top level management in the form of the project manager, will lead to the successful development and implementations of NALCOMIS MODULE I, as well as other similiar MIS. (That is, providing the project manager takes an active interest and positive active action in regards to those users and their organizations.)

The objectives of this thesis are outlined below:

1. To demonstrate the types of changes possible in organizational structure, job content, control in organizations, and communication patterns that may result from the introduction of NALCOMIS MODULE I into the IMA, OMA, and SSC in aviation maintenance activities.

2. To show that when the project manager of NALCOMIS MODULE I is considering the application of the OLRT computer-based management information system in the NAMP, he must understand and carefully match the MIS with the organization.

3. To describe some of the many psychological and possible social issues that may result in organizational conflict between the MIS development, design, and implementation staff and the users.

4. To propose recommendations that will:

a. Resolve some possible intrinsic conflicts that on-line real-time MIS introduction tends to highlight.

b. Minimize the adverse impact and behavioral effects that result from an OLRT MIS.

B. RESEARCH PROBLEM

The accumulation of definitive aircraft operational, maintenance, and logistics support information, and the eventual distribution of this information throughout all levels of the Naval Aviation community, has become a paramount effort in Naval Aviation Maintenance since the early 1960's. Previous to this time, most aircraft logistical support, maintenance, and operational data were only available at the local levels of management. The few up-line

reports available consisted of aggregated information of a basic nature pertaining to performance/operational measurements. The pressures of "cost effectiveness" and "readiness versus costs" issues (during the late 60's) highlighted the need to review and change the methods in which the Navy did its business of supporting Naval aircraft. The Navy took action to modernize its maintenance management and logistical support information system. It developed procedures to collect the data to support those revised concepts. For the first time, those procedures were standardized Navy-wide. The Naval aviation environment is centered around Naval Air Stations and aircraft carriers. It was there that the first limited-capability batch-processing computers and limited communications equipment were installed. With these installations, the Naval Aviation Maintenance and Material Management System, the 3-M system, was born.

The 3-M system was developed around an Electronic Accounting Machine (EAM) capability, with the purpose of providing Naval staff managers, reliability-maintainability engineers, contractors, and other key support personnel with deeper insight and data about maintenance and logistics efforts in the field. The local managers were only provided short-term historical data for use in trend analysis. The collection of this data has become vital in the 3-M system.

The eventual goal of the 3-M system was to provide timely and accurate information to all levels of management. However, due to budget limitations and to the tempo of military operations, little state-of-the-art equipment for MIS improvement had been developed. The improvements to the entire aviation 3-M system have been greatly limited during a time when major changes have been needed.

The major weak point of the Aviation 3-M MIS has been the lack of development of an effective man-machine interface to collect, process, and make available maintenance management data at the local level in an accurate and timely manner. Manually, the present system consists of a mix of grease-boards, Visual Display (VIDS) boards, and pencil and paper, together with a great amount of technical personnel processing information. The conventional source document keypunch/conversion orientation has been the major reason

for the excessive delays experienced throughout the present 3-M MIS. This has proven to be a weakness in the system which has caused a lack of confidence and acceptance of data received throughout the Aviation 3-M system.

More complex aircraft, weapons systems, and support equipment require more maintenance actions and more source documents for data collection. The sheer volume of information available and data required has bogged down the present manual batch-processed management information data processing system of Aviation 3-M. The Chief of Naval Operations (CNO) was made aware of the requirements and deficiencies of the present system, and through his efforts and direction, an on-line real-time MIS project called NALCOMIS was chartered. This OLRT MIS is an effort to update the aviation 3-M system into an MIS which can respond not only to the data requirements of up-line reporting but also can provide local level managers with information to make day-to-day management decisions in aviation maintenance support. The aviation 3-M system and NALCOMIS will interact to become an on-line real-time aviation maintenance management information system. They will form a single information system to support the management decision making process at all levels of management.

What is a Management Information System? It is best described by its parts or components. This study accepts the view (Defense Documentation Center, 1971) that "Management Information Systems are composed of people, equipment, policies, and organizational structure, and are concerned with the information and decision process which guide and control the behavior of an enterprise." A more succinct view is expressed by Mason and Mitroff (1973) was proposed that "an information system consists of at least one *person* of a certain *psychological type* who faces a *problem* within some *organizational context* for which he needs some *evidence* to arrive at a solution and that the evidence is made available to him through some *mode of presentation.*" The most interesting aspect of views proposed by Mason and Mitroff deals with the "interdependency of information systems and the organizational structure" and its interdependency with the people who play

organizational roles." Here we will strive to study the impact of an MIS, (namely NALCOMIS), on the organizational structure of aviation maintenance activities and the people (users) within those organizations.

Ein-Dor and Segev (1978) concluded that each organization must develop its own MIS strategy which best fits its particular situation—an issue not addressed by the NALCOMIS ADS plan. However, this is an issue which should be faced by the FMSO Project Manager for NALCOMIS in his development planning.

What is an on-line real-time computer system? An "on-line system" is usually defined as a system which will minimize the need for human intervention between source data recording and the ultimate processing by the computer (Chapman, [1965, p. 17]). A real-time system is designed to accept various data entries simultaneously and to process that data on a transaction by transaction basis as it arrives. This transaction reporting is the basis of the real-time system. On-line real-time computer systems have the characteristics of: random-access capability, development of sophisticated point-of-origin devices (terminals), and an improved communication network. When an MIS is computerized with an on-line real-time computer system the result can be called an "on-line real-time computer based management information system!" The NALCOMIS system is such an MIS and the subject of discussion.

C. APPROACH

The investigation documented here is intended to act as an educational tool to provide experience and knowledge that may prove valuable to the NALCOMIS MODULE I Project Manager at the Fleet Material Support Office (FMSO) and to the central software system design agency for NALCOMIS. The project will provide an academic discussion, but will not be limited to secondary sources only. The secondary sources used will include university and government libraries and selected periodicals.

Primary sources will include a personal interview with the FMSO NALCOMIS Project Manager. Telephone interviews will be conducted with other project managers in the civilian and Naval aviation maintenance community.

Chapter II will provide the definition of the NALCOMIS MODULE I system. It will discuss the history and general background of NALCOMIS, the major user personnel which will be impacted in aviation maintenance activities, and will discuss the advantages of using NALCOMIS to carry out NAMP policy.

Chapter III is an analysis of the impacts of NALCOMIS as an OLRT MIS on user personnel and the organizational structure in their aviation maintenance activity role. It will discuss such topics as IMA, OMA, and SSC operations. The management styles, feedback systems, and interactions of user personnel will be addressed.

Chapter IV will include a summary of OLRT MIS systems and NALCOMIS as workable systems. Recommendations on successful implementation procedures in regards to user personnel will be suggested.

II. THE NAVAL AVIATION MAINTENANCE EFFORT — BACKGROUND AND PERSPECTIVE

The NAMP (Naval Aviation Maintenance Program), providing an all-encompassing system for accomplishing aviation equipment maintenance and other related supporting functions, was established by the CNO (Chief of Naval Operations) on 26 May 1959. It was implemented on 26 October 1959 by the (then) Chief, Bureau of Aeronautics. The NAMP is a dynamic program for the accomplishment of Naval Aviation Equipment Maintenance. The program has been revised continually to incorporate many new methods and techniques for the control and completion of 175 objectives. An example of these objectives is the three level maintenance concept. This concept was designed and implemented to provide for the optimal utilization of manpower, facilities, funds, and material. The three levels are the OMA (Organizational Maintenance Activity), the IMA (Intermediate Maintenance Activity), and the Depot Maintenance Activity. Only the OMA and IMA will be discussed here, since NALCOMIS Module I will not address the Depot Activities. The OMA level is where "on-equipment" corrective and preventative maintenance is performed. This maintenance includes "on-equipment" repair and "on-equipment" removal and replacement of defective components and parts. At the IMA, maintenance repair actions are performed on the removed repairable components. This level is considered to be "off-equipment" repair or work.

The background of the NALCOMIS program will be addressed in this section. It will include the various efforts and improvements that have been tried to gain overall improvement of the NAMP and the logistics material support, the NALCOMIS Module I objectives, the existing procedures and methods used at the OMA, IMA, and Supply Support Center (SSC) Levels, and the expected limitations with proposed methods and procedures to be utilized under NALCOMIS Module I.

A. NAMP (NAVAL AVIATION MAINTENANCE PROGRAM) OBJECTIVES

An improvement to the NAMP has been the 3-M (Naval Aviation Maintenance and Material Management) system objective. This system was implemented on 1 January 1965

in an effort to provide for maintenance data collection, man-hour accounting, and aircraft accounting systems. In January of 1968, the CNO promulgated a consolidation of the numerous directives, regulations, and instructions into a single family of documents. A key factor emphasized has been that command attention is critical to the accomplishment of the stated objectives of the NAMP, as quoted below:

> "The objective of the NAMP is to achieve and maintain maximum material readiness, safety, and conservation of material through command attention, policy direction, technical direction, management, and administration of all programs affecting activities responsible for aviation maintenance, including associated material and equipment. It encompasses the accomplishment of repair of aeronautical equipment and material at the level of maintenance which will ensure optimum economic use of resources; the protection of weapons systems from corrosive elements through the prosecution of an active corrosion control program; the application of a systematic planned maintenance program; and the collection, analysis, and use of pertinent data in order to effectively improve our material readiness and safety while simultaneously increasing the efficient and economical management of our human, monetary, and material resources."

It was the accomplishment of these objectives which fostered the requirements of the OLRT MIS NALCOMIS.

B. NALCOMIS HISTORY

The accumulation of definitive aircraft operational, maintenance, and logistics support information, and the eventual distribution of this information throughout all levels of the Naval Aviation community, has become a paramount effort in Naval Aviation maintenance since the early 1960's. Previous to this time, most aircraft logistical support, maintenance, and operational data were only available at the local levels of management. The few up-line reports available consisted of aggregated information of a basic nature pertaining to performance/operational measurement. The pressures of "cost effectiveness" and "readiness versus costs" issues highlighted the need to review and change the methods by which the Navy did its business of supporting Naval aircraft. The Navy took action to modernize its maintenance management and logistical support information system. It developed procedures to collect the data to support these revised concepts. Navywide standardization of these data collection procedures was accomplsihed. The entire Naval Aviation environment is centered around Naval Air Stations (NAS) and aircraft carriers. It was aboard these

operational activities that the first limited capacity batch-processing computer-based MIS were installed. These MIS installations heralded the birth of the Naval Aviation Maintenance and Material Management System (3-M system).

The original purpose of the 3-M system was to provide reliability-maintainability engineers, government contractors, Naval Air Systems Command (NAVAIR) managers, and other support personnel with the information necessary to analyze maintenance and supply problems. The original capability of the 3-M system was limited by state-of-the-art Electronic Accounting Machine (EAM) technology. A more basic function of the 3-M system provided local IMA and OMA maintenance managers with "short-term" historical data which were used for maintenance/repair trend analysis. The 3-M system's prime purpose was data collection to be used by upper level management with limited use by lower level maintenance managers.

EAM technology required that manual documentation be converted to a usable format for up-line transfer to the central computer bank. The quality of this data was dependent upon the conversion of the manual formats to machine readable formats. Prime concern centered on inputting correct keypunch/conversion oriented data into the system. Aviation maintenance and supply were tasked with ensuring the correctness of their manual source data before and after keypunch conversion. This added a heavy documentation workload on technically oriented personnel. Over the long term, the 3-M system saw improvements in hardware and the MIS in general. The ultimate goal of this MIS was basically the same as any other, namely to "expose significant relationships that will decrease uncertainty in organizational decision making with a corresponding increase in the utilization of organization resources." (Nichols, 1969). In short, the 3-M MIS was to provide all levels of management with timely and accurate information with minimum costs. Advanced technological development in the early 1970's of the 3-M MIS had been limited by high-tempo military requirements, budget limitations, and operational commitments.

Navywide, the standardization for coding logistics data is the 3-M system's strong point. This has permitted machine processing of data received from all aviation maintenance

activities. There has been, however, a general lack of confidence in machine reports because of the *ineffective*, error-prone methods of data collection and processing at the local levels. This "man-machine interface" has proven to be the major weakness in the 3-M system. Accuracy and timeliness are the qualitative aspects of 3-M data needs to make the 3-M MIS a viable tool for the maintenance manager.

In addition to the standard 3-M data requirements, maintenance managers are being deluged with requests from upper level management (i.e., NAVAIR) for various other maintenance, supply, personnel, and operational information. These added requirements are a direct result of applications of advanced technology in the development and operational use of complex aircraft and weapons sytems. Simply stated, more complex aircraft (such as, weapons systems and support equipment) require more maintenance actions and more source documents for data collection. The sheer volume has bogged down the present EAM (manual input, batch process 3-M MIS). Space constraints and budgetary restrictions have given rise to local hardware being used by the 3-M system to be utilized for supply, disbursing, and personnel functions, in addition to its prime function to support the aviation 3-M program. Design limitations have limited the processing capacity of the hardware, which has resulted in excessive delays of aviation 3-M data processing, further complicating the processing of required up-line reporting with accuracy and timeliness. Local management data monitoring and trend analysis capability have also suffered in the long term. To put this problem in the words of the NALCOMIS Module I Automated Data System Development Plan (ADS PLAN), "The information required by command management on which to base decisions is rendered stagnant by outmoded data systems. Reports needed within hours/days often take days/weeks to produce." (ADS PLAN) Because the data requirements still existed and the 3-M system batch-processing procedures were often back-logged, operational commanders were forced to develop local "one-of-a-kind" MIS. This was done to the detriment of direct aviation maintenance support. These local systems and the larger 3-M system (in its present form) could not respond in the required manner to command information requirements. There were several attempts, both afloat and ashore,

to resolve some of the major 3-M deficiencies in information flow and up-line reporting. The systems most noteworthy were the BUNKER-RAMO 700 test at Marine Corps Air Station, Santa Ana, the IMA WIPICS (Intermediate Maintenance Activity Work-in-Process-Inventory Control System) at NAS MIRAMAR, California, the SIDMS (Status, Inventory, Data Management and Supply Support System) onboard the U.S.S. John F. Kennedy (CV-67), the FAMMS system (the Fixed Allowance Management Monitoring System) at NAS JACKSONVILLE, Florida, and a civilian system SCEPTRE (System Computerized for Economical Performance, Tracking, Recording and Evaluation) used by Republic Airlines, Minneapolis, Minnesota. All of these systems were computer-based, on-line, real-time, distributed, processing management information systems attempting to improve the "man-machine interface" of data and information flow.

C. PROTOTYPE ON-LINE REAL-TIME SYSTEMS

1. The Bunker-Ramo 700 Information System

Bunker-Ramo Electronics Systems Division (located at 31717 La Tienda Drive, Westlake Village, California) developed the BR-700 Information System, which was used by the 3rd Marine Airwing at El Toro, California during the Source Data Automation Concept evaluation in early 1970. The Marine Aircraft Maintenance Program is part of the overall Naval Aviation Maintenance Program (NAMP). The test with the BR-700 information systems was, in effect, an attempt to automate the 3-M system on an on-line real-time basis. Implementation of the initial effort was at the OMA level in a CH-46 Hilicopter Training Squadron. It must be remembered that the OMA is the original source data collection starting point for most aviation maintenance actions.

The BR-700 consisted of a memory storage unit and CPU which was linked to 16 non-programable CRT terminals. A communications interface module was provided to link the system to other computers, readers, dataphones, and teletypes. The CRT terminals (the interface device between the user and the system) allowed access to electronic data files, for evaluation, display, editing, correcting, or off-line printing. A specialized data base consisted of a dictionary, a listing of code letters, a collection of commonly used formulas, and

an index to stored data. Key work areas/centers were outfitted with CRT terminals and printers. (See Figure 1.) The information flow through the OMA is seen in Figure 2. Maintenance actions flowed through an extensive network of control points and work centers which made entries as part of the central data collection effort. Since the data base was constantly updated and centrally stored, various status reports were available for display or printed out a real-time base. "The Squadron Commander and the maintenance managers had a completely up-to-date picture of the maintenance status which permitted effective management of operations and resources."

Repair of a reported aircraft discrepancy was a serial operation. Briefly, the pilot reported the discrepancy on a standard format. Certain repetitive administrative data, (e.g., aircraft number, serial number, etc.) were also entered into the format. This data became the sole source for other actions associated with this particular discrepancy. Since it was centrally stored, it could be recalled as each work center or terminal user required.

The discrepancy was entered by terminal and was displayed at maintenance control. The operator then electronically notified the selected work center via terminal for MAF maintenance work assignment. This action simultaneously updated the aircraft status and aircraft register file. A real-time picture of aircraft availability, which was used by management, was displayed.

At the work center level, a technician was assigned the MAF for corrective action. By using the MAF format on the CRT, work centers were able to update automatically the data base. The maintennance control center was motified of MAF completion via CRT terminal. Additionally, the flight line was notified of aircraft status changes. The system facilitated workload scheduling and provided aircraft readiness status on a real-time basis. BR-700 system evaluation revealed user acceptance and confidence at the 95 percent level of information accuracy and dependability.

The non-quantifiable benefits from this test are most interesting in regards to the future NALCOMIS Module I Implementation.

EQUIPMENT INSTALLATION

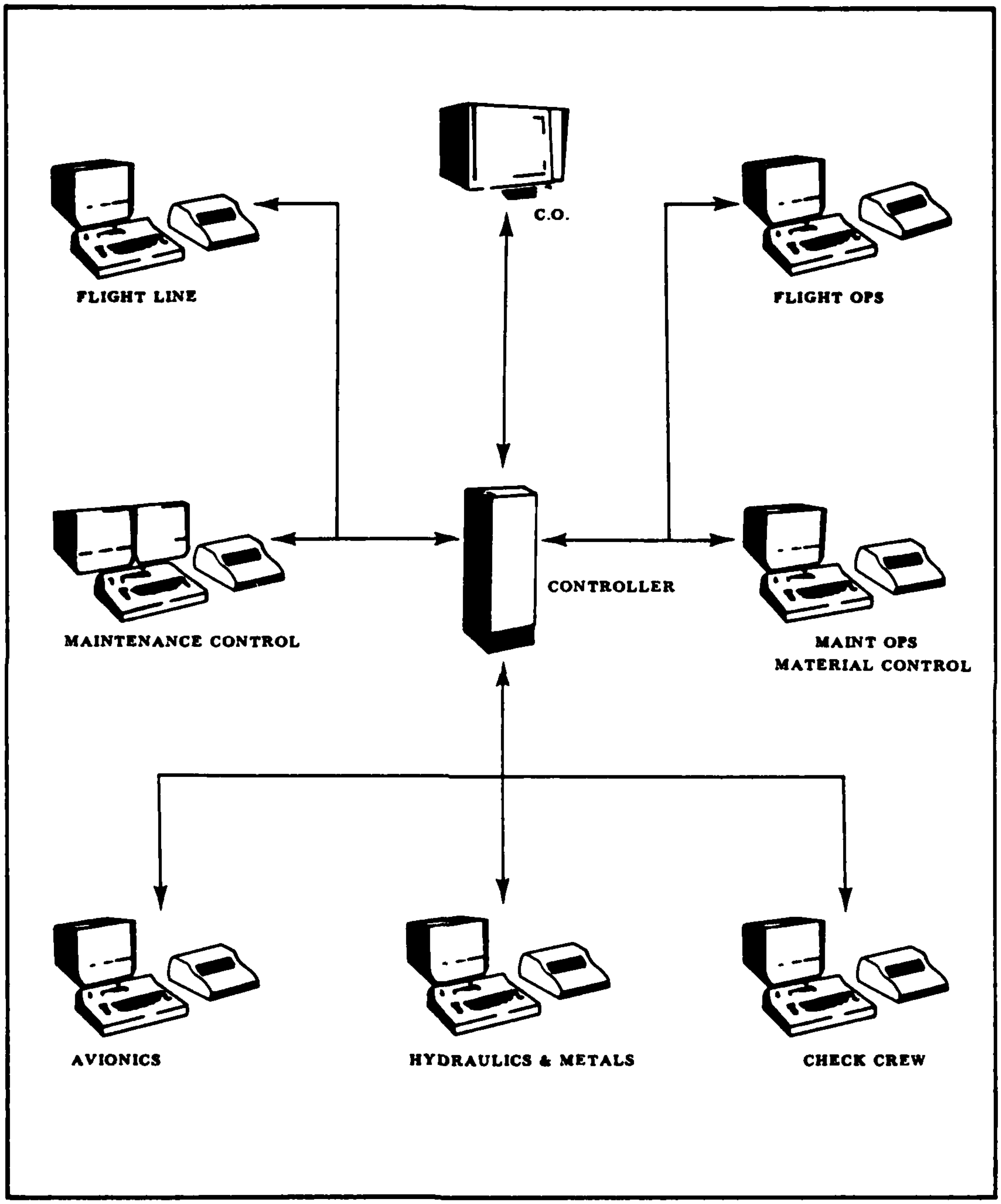


FIGURE 1: MARINE AIRCRAFT MAINTENANCE

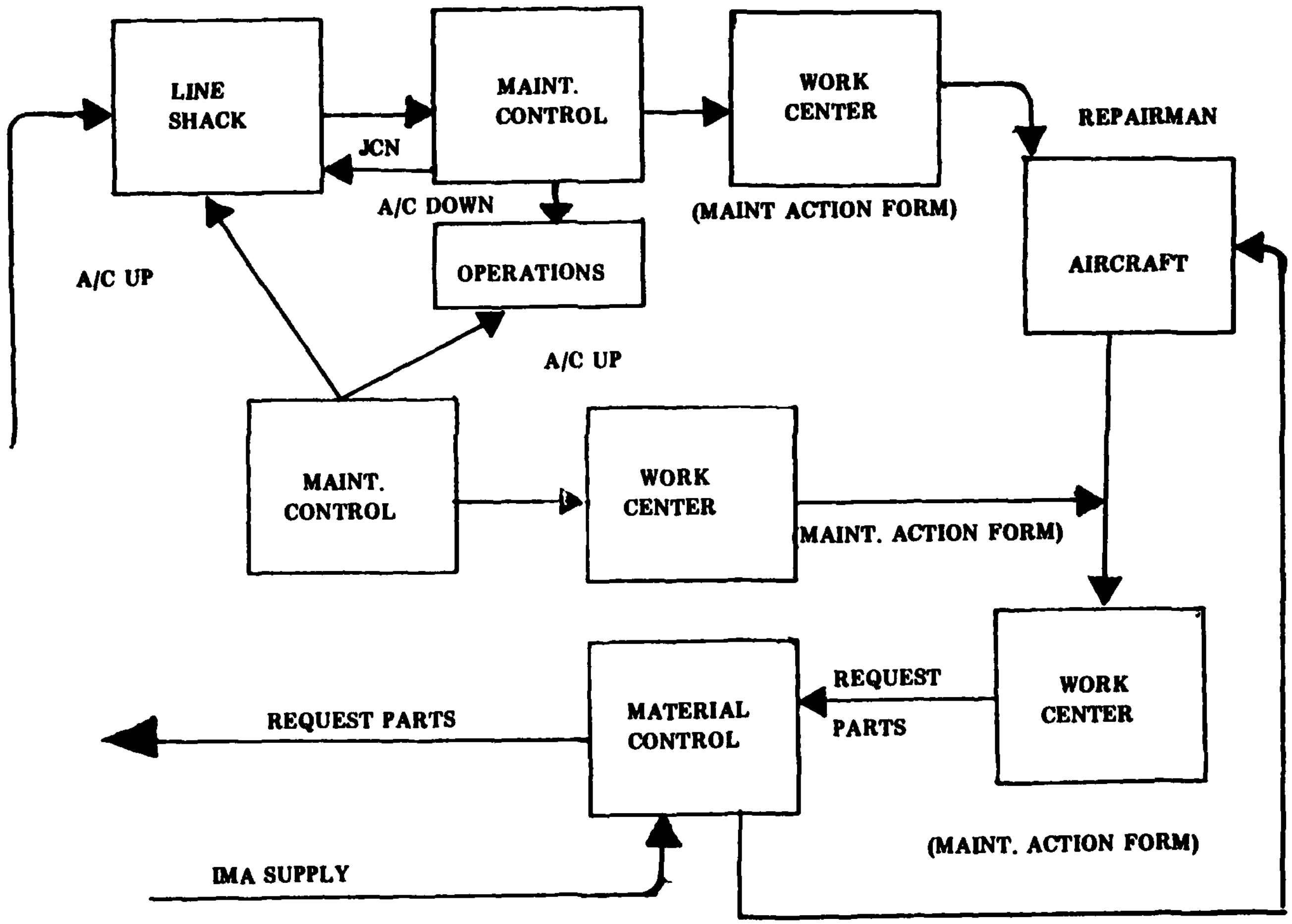


FIGURE 2: BR 700 INFORMATION FLOW
(From the Marine Corps Gazette, Wilson, W.E., Jan. 1972, p. 29)

A few of them are listed here:

- Maintenance control registers and status boards available, accurate, and timely.
- Redundancies and errors reduced.
- Time required of first-line managers for detection and correction of errors reduced significantly.
- Standardized procedures and formats increased the visibility of document flow for first-line supervisors and middle management.
- Workload scheduling simplified and more easily prioritized.
- Valid and reliable information available at the lowest levels of management for use in decision making.
- Everyone in the system has access to information. Key personnel are no longer the only ones with the total picture.
- Supervisors, managers, and workers reported greater job satisfaction due to "greater involvement on the job and greater piece of mind off duty."

From the features described, the BR-700 information system was essentially an on-line real-time MIS used successfully at the OMA by various levels of management.

2. Intermediate Maintenance Activity Work-in-Process Inventory Control System (IMA WIPCIS).

The IMA WIPICS MIS was an on-line real-time, computerized production control and inventory tracking system. IMA WIPICS' objective was to assist IMA maintenance managers at NAS MIRAMAR, California to meet the goals of the NAMP, which are "Readiness. . .and. . .the efficient and economical management of our human, monetary, and material resources (NAMP). It was designed to improve visibility of naval aviation requirements and priorities, workload status, and resources. Operation of the system was aimed at the shore-based IMA and the Supply Department, SSC (Supply Support Center).

Specifically, IMA WIPICS was designed to reduce costs in the processing of repairable components through the IMA. The IMA WIPICS software was the IMA (Information Management System) developed by IBM and adpted by Rohr Industries, Inc., the contractor.

Hardware at the Rohr ADP facility included two IBM 360/65 computers, one 360/65 was a back-up, an audio response control unit, a disk storage facility, equipment for the conversion of telecommunications signals, and an IBM 1403 printer. The equipment

suite at NAS MIRAMAR was composed of push-button numeric telephone terminals (which were linked via a concentrator and special lines to the Rohr computer located in Chula Vista), Waveter Alphanumeric terminals, and NCR (National Cash Register) 260 teleprinters. The numeric and alpha-numeric terminals provided audio-prompting for operators, received and transmitted input, and transmitted audio responses to queries.

The teleprinters produced on-line, real-time automatic exception reports, and hand-copy responses to queries. The input/audio response terminals were located in the Avionics Division's Production Control Branch, the CCS Pool unit (Component Control section), the AIMD/Supply screening unit, and the Material Division office. Teleprinters were located in Production Control, and the CCS Pool unit. The hardware configuration is exhibited in Figure 3.

The IMA WIPICS MIS Tracked/Monitored repair of each component from the time it was due (IOU) from an OMA, through screening and repair, and/or until it was ready for issue (RFI) or declared BCM (Beyond Capability of Maintenance). This serial action can be seen in Figure 4. The inputs via remote keyboard terminals operated by Navy enlisted personnel were in the AIMD Production Control and Supply CCS. On-line output was in the form of teleprinter response and audio signals, with automatic exception reports warning of critical conditions, e.g., low RFI stock, excessive AWP (Awaiting Parts) status, etc. Some off-line reporting was made in the form of management summaries, complete inventory listings, repair cycle data, and authorized inventory level computations.

Additional billets were not required to operate IMA WIPICS because existing personnel used the system during the course of their regular work. Management was impressed with the improved visibility of repairables in process tracking using an on-line real-time MIS. It used the new visibility to assign priorities and more efficiently allocated resources during workload scheduling. Although this prototype on-line MIS at NAS MIRAMAR was used to support Avionics components, the design capabilities included power plants support, airframes, ground support equipment, and other equipment support as well.

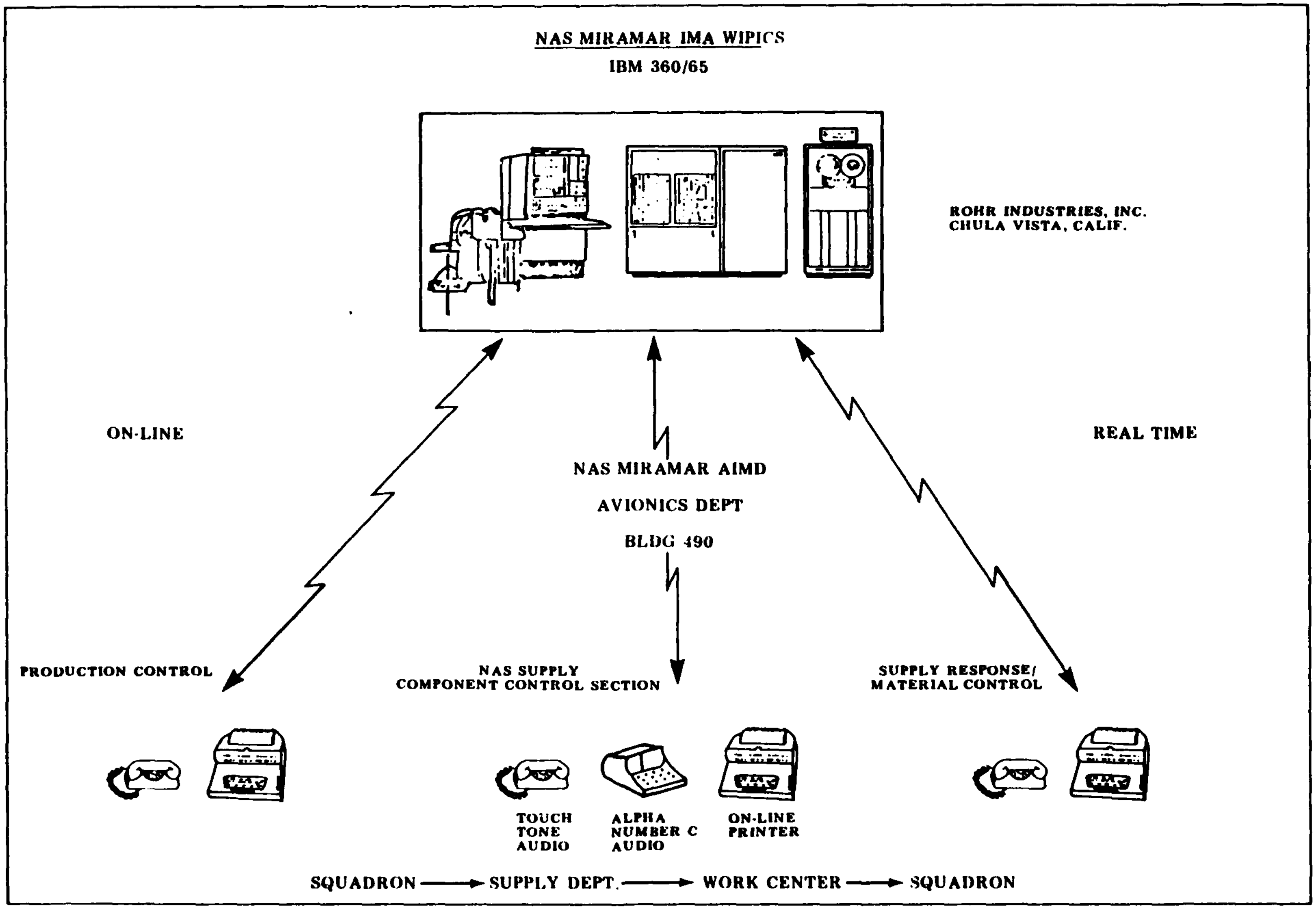


FIGURE 3: IMA WIPICS Equipment Configuration

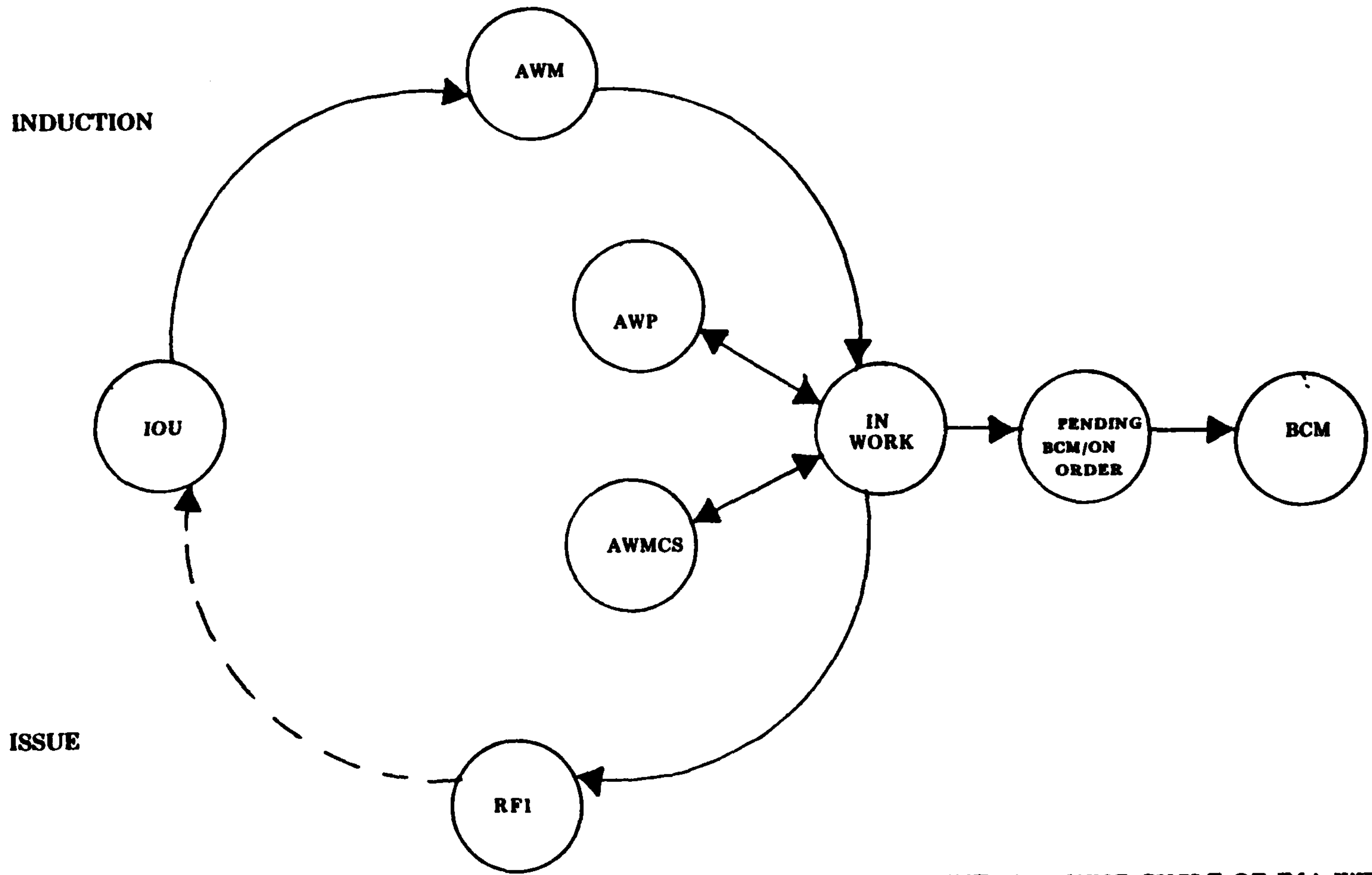


FIGURE 4: COMPONENT TRACKING CYCLE OF IMA WIPICS

Some benefits of the IMA WIPICS MIS systems are listed here:

- Reduced equipment repair turnaround times.
- Controlled and managed inventory levels.
- Improved utilization of production direct and staff indirect labor.
- Supply department and AIMD personnel were enthusiastic about the system because it "made their jobs easier."

Although the IMA WIPICS systems had implementation and operating problems with hardware utilization over land-lines between Chula Vista and NAS MIRAMAR, the system received favorable comment and recommendation from the Commanding Officer, NAS MIRAMAR.

3. Status Inventory Data Management Supply Support System (SIDMS)

The afloat (aircraft intermediate maintenance department) IMA and (an aviation supply support activity) SSC joined forces to implement a mechanized/automated operation and management information system. This MIS (called the Status Inventory Data Management Supply Support Systems—hereafter referred to as SIDMS) was designed to operate as a management decision tool at the functional management level, a real-time production control system and an order processing system at the operational level. SIDMS was designed because the inplace data collection system (the manual AIMD production display boards and manual/automated order/inventory processing systems on board this aircraft carrier) proved to be unresponsive to the real-time needs of the IMA, Supply Department, SSC, and the embarked Combat Airwing. (It must be remembered that aviation maintenance of high speed combat aircraft requires quick repair turn-around times and accurate supply support status. Maintenance managers and operational aircraft users must have accurate planning information in real-time terms.)

SIDMS was conceived as an on-line real-time management information system. The major users are the IMA management staff, the IMA production control supervisors, the IMA work centers, the aviation supply support center, and the squadrons of the embarked combat airwing. There is a total of approximately 32 individual user terminals on-line at any one time.

An overview of the major software systems in operation is listed below:

a. Major Software Systems:

Order processing system	• Order processing for the supply support center/AWP locker. • Order processing for the airwing squadron material controls. • Order processing for the IMA work centers.
Production Control	• IMA inhouse production control of repairable units inducted for repair. • IMA inhouse GSB production control of major support items.
Inventory Control	• Aviation supply inventory control of over 44,000 line items. • IMA support equipment status/inventory. • IMA GSB inventory control.
Personnel/manpower system	• Listing of AIMD/airwing, personnel roster cross-indexed, name, rate, social security number, duty section, and squadron assigned.

The hardware system consists of 32 CRT non-programable terminals, two tape drives, two 600 line/minute printers, a Varian central processing unit, two teletype printers, two 1000 line/minute thermal printers, two remote TV CRT monitors and two disk drives. Vendor support was provided under limited contract during user installation of the hardware system.

The software was developed locally with vendor support. Two types of reporting are provided by SIDMS with monthly and on-line reports. The monthly reports include an IMA inventory of support equipment, IMA personnel rosters, aviation parts inventory, and location for supply and maintenance data reports of repair items processed by the IMA work centers. These monthly reports are compiled and processed from stored data on tapes and disk packs collected on a daily basis from the active DOC drive units. The on-line reports are available to selected terminals for management and production control. The on-line reports include production control registers for work centers, ground support equipment production status, aviation parts inventory search (with location information), and personnel roster access.

The order processing function provides a direct tie between the squadron requiring an aviation part and the supply department. When a part is required, an order form is called up on the user terminal, the appropriate blocks filled in, and the order is sent to the Aviation Supply Support Center, where it is typed directly on a DD-1348 requisition form. SIDMS provides bin/storeroom data with each order. If the item is not carried (NC), it is so indicated. This NC information is stored for use on monthly reports provided to the Aviation Supply Support Center.

The IMA Production Control Centers, the IMA work centers, and the IMA management staff are able to log on the real-time system. As an item is inducted for repair within the IMA, it is tracked via the on-line system through the entire repair cycle. Its status is available at any time during the cycle. These include in-work, ready for issue, and awaiting parts status.

Administrative and manpower functions are available with the real-time on-line system. Any maintenance technician's status (on board, duty, TAD) can be shown on the CRT terminal screen. This capability allows the management staff to provide lists as required and to plan manpower requirements for airwing support.

System hardware maintenance is a shared responsibility. The IMA provides on-site technicians and the vendor provides technical representative assistance, as required. System software is developed locally, but the vendor controls the rights on the software package at present. Figure 5 depicts the hardware configuration on board the afloat IMA.

4. Fixed Allowance Management Monitoring System (FAMMS)

The FAMMS MIS is a mechanized (read computerized) system used to monitor the repair cycle of components at the depot and IMA levels of aviation maintenance. It monitors repair actions and controls rotatable pod management for the SSC. This is an on-line real-time MIS installed at NAS JACKSONVILLE. It is a prototype on-line real-time MIS which has been relatively successful.

The FAMMS system inputs begin with a repairable component demand at the SSC by a customer—usually this is an OMA. These demands are processed on a one-for-one

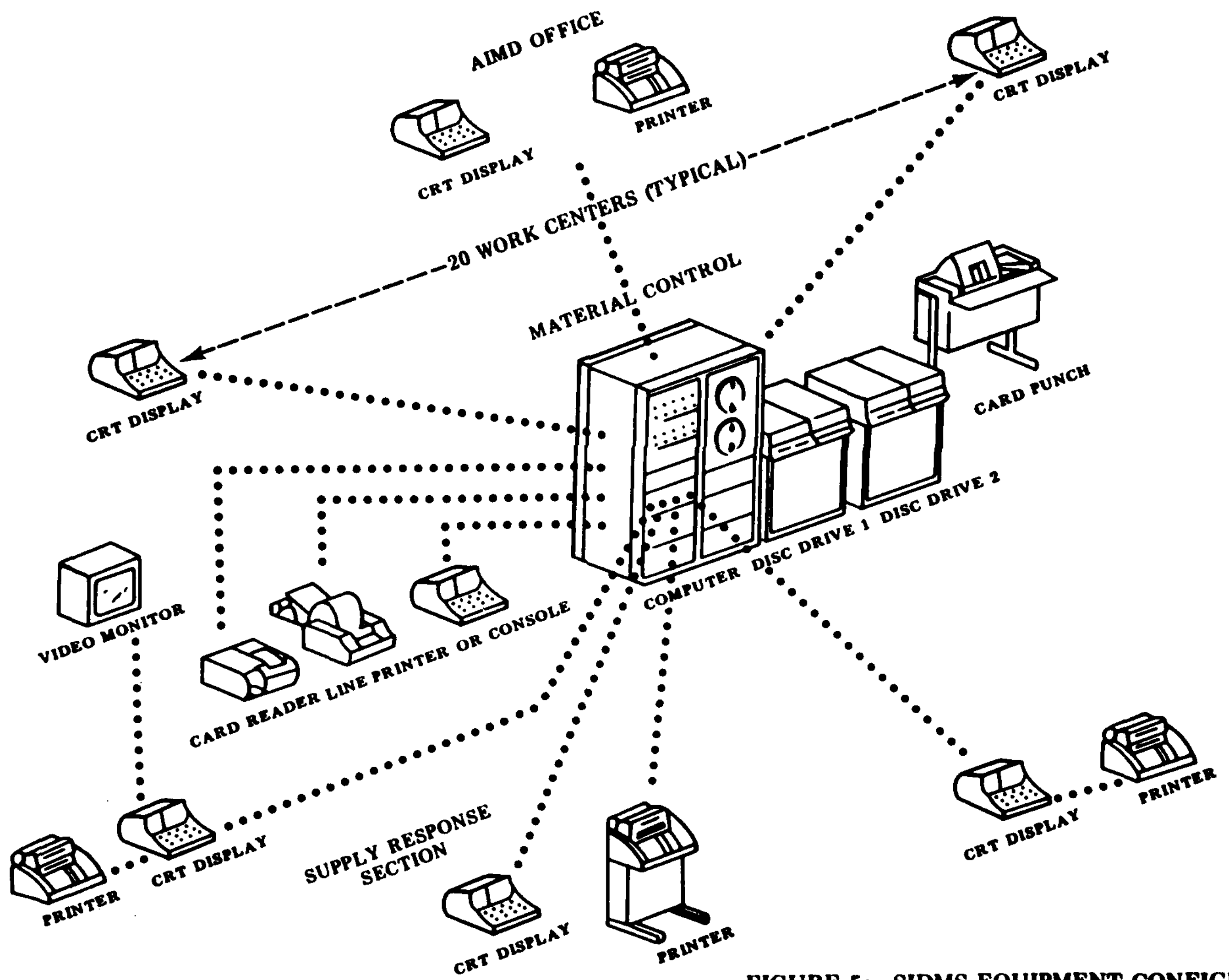


FIGURE 5: SIDMS EQUIPMENT CONFIGURATION

exchange basis, i.e., a non-RFI component is exchanged for an RFI component. Adjustments are made to the data file at that time. An I.O.U. control file is established to allow OMA's to carry out-flight operations with degraded aircraft weapons systems. Assets are tracked through the repair cycle from the date and time when it was removed from an aircraft through the final repair action. Asset status is one of the following throughout the cycle:

a. I.O.U.
b. Awaiting Maintenance (AWM)
c. In work (IW)
d. Awaiting Parts (AWP)
e. Ready for Issue (RFI)
f. Beyond the Capability of Maintenance (BCM)

The hours and the number of times in each above status is recorded. FAMMS provides direct induction capability into the repair cycle. In addition to those reports required by upper level management, various management and statistical reports on performance and effectiveness measurement are also required, generated either by Batch Processing (PCC) or on-line through the CRT terminal.

The FAMMS systems is a limited dispersed on-line real-time computer-based MIS. Transactions are input, files updated, and inquiries made via CRT terminals. Hard copy formats are printed from CRT displays. All the dispersed CRT terminals are tied through a "terminal concentrator," which links the CRT terminal to a mainframe computer. There are several dedicated printers for demand documents and reports. The use of CRT terminals provides informative visual displays for users and expands the MIS input/output capability. Because FAMMS is electronically mechanized, it is more accurate than the manual MIS system it replaced.

FAMMS has been successful as an on-line real-time MIS for tracking repairables through the IMA and SSC of a Naval Air Station (NAS).

5. <u>System Computerized for Economical Performance, Tracking, Recording, and Evaluation (SCEPTRE)</u>

SCEPTRE is an on-line real-time MIS employed by Republic Airlines (with its corporate headquarters in Minneapolis, Minnesota). It is being discussed in this section because of its unique quality of being a working aviation maintenance MIS. (See Figure 6.)

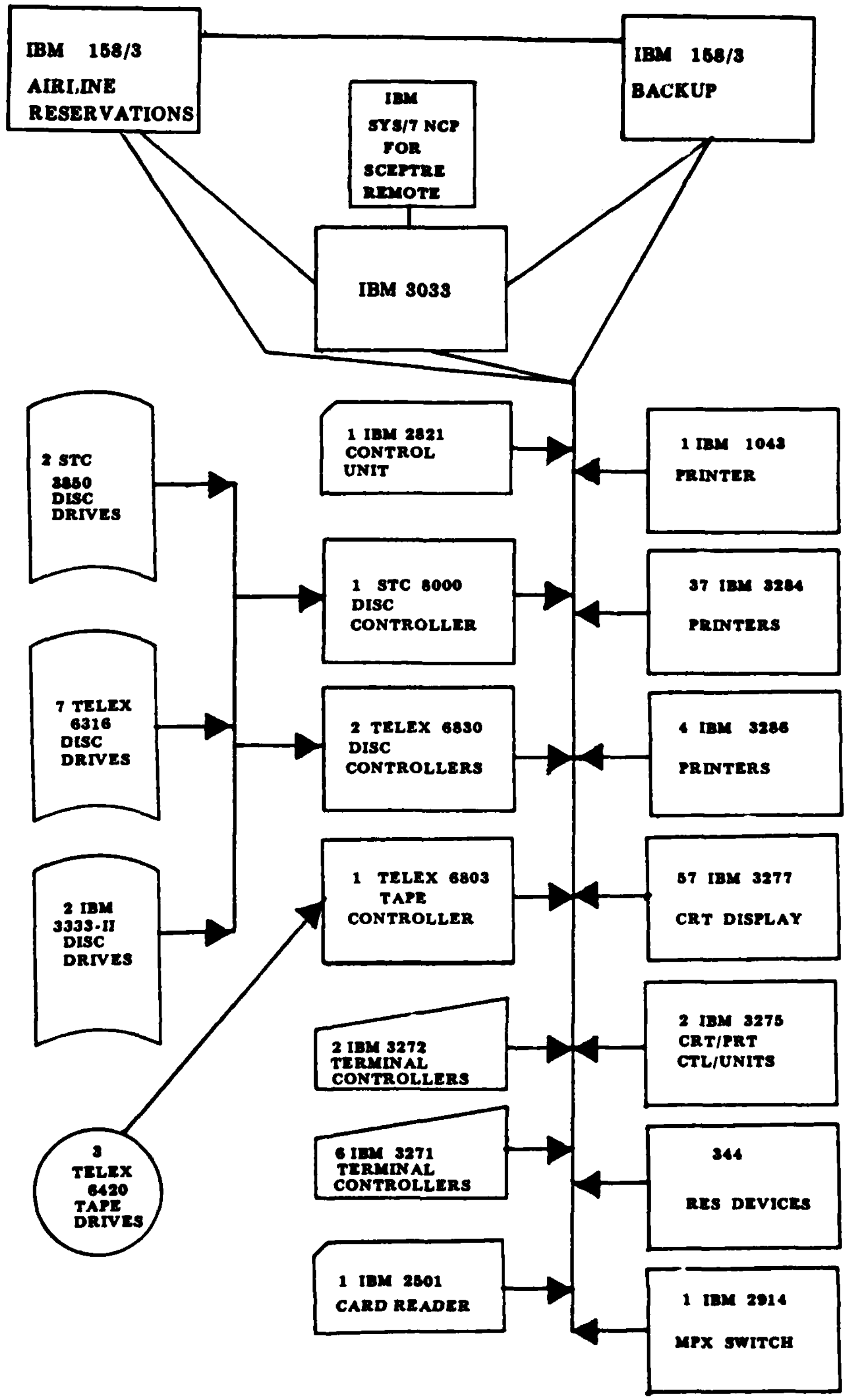


FIGURE 6: REPUBLIC AIRLINES SYSTEMS
FLOW CHART FOR SCEPTRE

Republic is a regional airline with repair facilities in Atlanta, Cleveland, Detroit, Chicago, and Minneapolis. The initial success of MIS has effectively reduced maintenance costs at Republic significantly. John Pennington, the Project Administrator comments... "With SCEPTRE, we can schedule maintenance so effectively, it's like having an extra DC-9 in our fleet. That's a $7 million saving right there." Republic flies 50 DC-9's and some Convar 580s.

Information, such as aircraft performance history, parts inventory and replacement forecasts, and inspection data are continually stored on an IBM computer at Republic's corporate headquarters in Minneapolis. A mechanic, executive, or pilot can check the maintenance status of any aircraft using one of 45 IBM CRT terminals located in the managers' offices, machine shops, and parts storage points. An added feature allows file access through Republic's IBM reservation terminals in the airports which are served by Republic.

Structure programming has been the technique used to develop the system. The IBM IMS (Information Management System) controls the data base. A complete maintenance history on the total Republic Fleet is maintained for historical informational and data requests.

The ADP manager claims a reduction of 10 percent in the maintenance budget for Republic. This system is continually under development for improvement (Schuline, 1979). SCEPTRE is a highly successful MIS system with a similar function to the NALCOMIS Module I MIS. The advantages of using this on-line real-time MIS are many and varied. The most outstanding feature is simply that it supplies the required information to all levels of management in a timely manner.

D. SACOMIS OBJECTIVES

The major weaknesses of the aviation 3-M system have been the subject of high level upper management attention. Complex aircraft, weapons systems, and support equipment required more maintenance actions and increased source document data collection to enormous volumes. The Carrier Aircraft Maintenance Support Improvement (CAMSI)

project was established by the CNO in 1970 to identify and prioritize the problems with the system. The CAMSI project analysis reported that an improvement in readiness could be achieved by making management of shipboard aviation maintenance and support more efficient. The use of improved Automated Data Processing Equipment (ADPE) was recommended by CAMSI to improve this management problem. In April, 1972, the Shipboard Aviation Command Management Information System (SACOMIS) was initiated by the Naval Air Systems Command (NAVAIR) and the Naval Supply Systems Command jointly in response to the CAMSI recommendations. PMA-260 was charged with direction control of SACOMIS. The project office, PMA-260, was supported by:

a. AIR-105 (for NAVAIR ADP policy and procedures).

b. AIR-411 (for aviation maintenance policy and procedures).

c. SUP-0454 (for NAVSOP ADP and supply policy and procedures)

d. Headquarters Marine Corps (HQMC) (for Marine aviation matters).

The Management System Development Office (MSDO) and the Fleet Material Support Office (FMSO) were tasked with the design effort for SACOMIS. The SACOMIS Automated Data System Development (ADS) plan was approved in concept by CNO (OP-91) in March of 1974. The SACOMIS program was expanded by CNO (OP-51) to include Naval Air Stations (NASs), Marine Aircraft Groups (MAGs), Helicopter Aircraft Carriers (LPHs), Helicopter 45 Assault Aircraft Carriers (LHAs), and Marine Corps Air Stations (MCASs). The new program title then became "Naval Aviation Logistics Command Management Information System" (NALCOMIS). PMA-260 was disestablished and Commander Naval Air Systems Command (AIR-105) was then designated as project manager for the new consolidated effort. There was initial concern that the project be user-oriented and acceptable by the fleet. In an attempt to satisfy this concern, CNO established the Fleet Oriented Review Committee Evaluating Naval Aviation Logistics Command Management Information System (FORCES) to review and evaluate NALCOMIS during the design, development, and implementation phases. FORCES served as a steering committee, helping to establish priorities for implementation, reviewing technical approaches, and providing some policy guidance.

FORCES was comprised of fleet and staff representatives. NALCOMIS continued to receive CNO emphasis as the method to improve and sustain aircraft readiness; November 1974 found the Marine Corp fully supporting NALCOMIS as a co-sponsor.

A draft of the ADS plan for NALCOMIS was informally reviewed by Navy/Marine Corps Headquarters staffs in September 1975. It was decided from their comments to develop the total NALCOMIS program using the modular approach. The initial thrust was to limit NALCOMIS support to the Organizational Maintenance Acttivities (OMAs), Intermediate Maintenance Activities (IMAs) and the Supply Support Centers (SSCs) afloat and ashore. This initial thrust or module has been identified as NALCOMIS Module I. The other functions of the Naval Aviation Maintenance Program (NAMP) will be defined and developed at a later time.

Program management for NALCOMIS was changed by NAVAIR in March 1976. The Aviation Program Coordinator (APC-5) was established by NAVAIR to serve as the manager for NALCOMIS development. APC-5 prepared the NALCOMIS Module 1 ADS Plan, which was required to obtain approval of the NALCOMIS concept from the Assistant Secretary of the Navy for Financial Management. In June 1976, NALCOMIS was officially designated a program in accordance with OPNAVINST 5000.42A. CNO directed the Chief of Naval Material (CNM) to consolidate a complementary management information systems with the NALCOMIS charter. This sytem was the visibility and management of support costs MIS (VAMOSC), which was redesignated as the NALCOMIS Operation and Support (O&S).

The Module I ADS Plan was completed and submitted in October 1976. It received certification in February 1977. In January 1977, APC-5 became a full PMA and was designated as PMA-270.

E. NALCOMIS OBJECTIVES

The Chief of Naval Material (CNM) described the overall objective of NALCOMIS in a response to the Vice Chief of Naval Operations (VCNO):

"3. The needs for the organizational and intermediate level maintenance and supply management information system portions of NALCOMIS can no longer be classed as 'ought-to-have' management imporvements. These requirements are now mandatory to prevent gross inefficiencies in fleet aviation material production and supply support. The CNM intends to monitor the NALCOMIS implementation plan closely to ensure scheduled adherence."

His comment supports the objective of Improved Aircraft Material Readiness through the means of providing local maintenance and material managers at the SSC, OMA, and IMA levels with a responsive MIS.

As described in the NALCOMIS Module I ADS Plan, the following are minimum system features.

- satisfy real-time information requirements of the base level aviation maintenance and material managers.
- satisfy the data reporting requirements for up-line information systems.
- satisfy mobility requirements of selected NALCOMIS Module I operational sites, specifically 12 CVs (aircraft carriers), 12 LPHs/LPAs (Helicopter Landing Platforms), 17 MAGs (Marine Air Groups), and deployable aircraft squadrons from 50 NASs and MCASs;
- satisfy minimum requirements for continuous operation of the MIS in a high readiness or mobilization environment considering:
  - vulnerability of hardware/software (including the data base)
  - security of data communications between afloat and ashore activities
  - satisfy fail-soft requirements to permit degrees of degraded mode operations versus total interruptions.

F. NALCOMIS SYSTEM FEATURES

Excerpts from a briefing by the NALCOMIS Project Manager, PMA-270 from NAVAIR, describes the system's features. It is an on-line, real-time, interactive and integrated MIS which is specifically designed to give local managers at the OMA, IMA, and SSC a management information tool to be used in the accomplishment of their assigned tasks. Initial design and testing efforts (called NALCOMIS Module I) covers those functional areas and requirements which were identified as the primary problems. The current management needs to solve these problems were considered the "prime candidates" for this first structured module. The entire evolution of NALCOMIS is looked upon as an evolutionary system, with other modules to be considered at a later time in system development.

The prime method of data collection, and information display would be via Source Data Entry (SDE) devices. The SDE devices would be strategically placed throughout the OMA, IMA, and SSC functions and in sufficient numbers to ensure an effective and efficient man-machine interface with NALCOMIS.

A Data Base Management System (DBMS) would manage the centralized data base and allow users to access any and all resident data. This feature highlights the interactive integrated capability of the system with users and the system. Data Security is a recognized issue and is being addressed during system development. User access from one organization to certain data of other organizations would be highly restricted. The NALCOMIS user, in many cases, would be dployable aircraft squadrons. To provide for data security and integrity, all data would be identified to a specific activity. By this way, the system provides for the receipt and transfer of data when aircraft are transferred between NALCOMIS sites, from a non-NALCOMIS site to a NALCOMIS site , or from a NALCOMIS site to a non-NALCOMIS site.

Probably the most important feature of NALCOMIS and its major objective is the provision of user-oriented service. User-oriented features include pre-formated displays for entry of data, entry of generic or common English data (instead of coded data with the system converting the data into code), and system generation of data from inputs of other data, (e.g., system generating aircraft bureau number, type equipment code, type/model/series, organizational unit, etc.) with the entry of aircraft side number (MODEX).

The system would provide the means for recording and retaining data about:

- aircraft, engines, and components.
- ground support equipment (GSE) utilization and inventory
- scheduled and unscheduled maintenance requirements
- material requirements
- support functions
- maintenance personnel management.

There are many conditions which influence or dictate management decisions in the allocation of aviation maintenance resources. A few of those conditions and demands are listed here:

- varying management policies
- operational location (sea or shore, CONUS or ex-CONUS, OMA or IMA)
- mission commitment to include operational, training or support
- type/model/series of equipment being managed or supported.

In an effort to limit the amount of reports generated, the system would provide the capability to access previously defined reports, and would be capable of developing unique reports for specific situations and conditions. Pre-defined reports would be qualified by the following criteria:

- data content and format would be fairly stable or fixed in nature.
- the reporting requirements would be universal throughout Naval aviation.
- labor savings and timely availability of data results would be realized by the system processing the reports.
- local managers would realize a high information value from reports processed.
- the majority of data required for reporting would be already in the data base.

The unique reporting requirements would be satisfied by an *ad hoc* (free form) generation capability. The sytem would also be able to establish the free form reports as preformated reports, once these are validated and qualified. Two types of reporting (up-line and local) would be available.

Local reports generated would be output in two ways: Hard copy printouts on an as needed exception basis by terminal printer or high speed printer and by the visual or CRT display. Which output to be specified would be determined by the following criteria.

Visual Display

- The amount of data to be provided would be displayed in no more than three screen displays.
- The data would be subjected to continuous updating and, as such, would possess short-term informational value.

- There would be no local requirement for maintaining a permanent record of the data being presented.

Terminal Hard Copy Printout

- Amount of data to be provided either would be in excess of three screen displays or the informational value of the product would be degraded if reviewed as a multi-page display.

- Local management requirements would necessitate hard copy for detail review, as in the case of performance and/or trend analyses.

- Product would be required as part of the manual fallback requirements.

System High Speed Printer

- The volume of data to be provided would be in excess of terminal printer's capability (ten or more screen displays).

- Product would be a continuing requirement and would have an established time period for generation.

- Management's need for product would not be of an urgent nature and could sustain the inherent administrative processing and handling delays.

Up-line reports would be those required by external upper level management. These upper level requirements would include the Naval Aviation Maintenance Support Office (NAMSO), Naval Safety Center (NAVSAFCEN), type commanders (TYCOMS), Airwing Maintenance and operational Staff, just to name a few. All up-line reports would be by a machine-readable medium, such as magnetic tape, card, or disk, or by hardcopy printed format.

Accuracy and validity of data entered into the system would be checked through a combination of sight verification and computer validation. Data characteristics, such as general edit requirements for alphanumeric configuration and mandatory-optional data elements, would be used as the basis of validation. Transactions containing data items failing validation would be rejected at the input device at time of entry and identifed with an appropriate diagnostic message. Edit and validation criteria would be in accordance with the requirements established by NAMSO and the NAVSAFCEN.

During periods of system down-time, a manual backup capability would be provided. A hard copy printout of the Maintenance Action Record (MAR) would be made available to users. The following is the procedure for the manual backup mode.

- Work Center. A copy of the MAR at time of initiation would usually satisfy this requirement. In those cases, where material demand is recorded subsequent to MAR initiation, an updated copy of the MAR containing material demand data would be provided to replace the previous hard copy.

- Quality Assurance. A copy of the MAR at time of initiation would satisfy this requirement.

- Material Control. When material demand is recorded on the MAR, a copy of the MAR would be provided to Material Control.

- Maintenance Control. A copy of each MAR at time of initiation and at time of completion would satisfy this requirement.

- Work Center. A copy of the MAR at time of initiation and at time of completion would satisfy this requirement.

- Production Control. A copy of the MAR at time of initiation, whether initiated within the IMA or passed to the IMA as a result of OMA action, would satisfy this requirement.

- Material Demands. Would be reflected in the maintenance Action Report and would be provided to the Supply Response Section (SRS) at the time a demand is initiated and when supply satisfies that demand. The MAR will be retained by the SRS for three working days. Any manual processing of MARs would be posted to the automated data records after system restoration. No classified information would be handled in NALCOMIS Module I. Security of information to prevent unauthorized data manipulation would be provided through procedural limitations and, when necessary, through the use of magnetic card reader devices. System design would address the use of limited access for tapes, disk packs, printouts, and specific procedures for requesting special runs.

Now that the design features have been presented, a typical scenario, as viewed by the work center supervisor, Maintenance Control superivsor, or Maintenance Control Officer, will be addressed as follows:

1. The aircrew records the equipment complaint or discrepancy on the "yellow sheet."

2. The maintenance control supervisor reviews the "yellow sheet" and enters the data into the CRT terminal in Maintenance Control.

a. Terminal entry access (limited to specific levels and authority by a magnetic card reader.

b. User identified by Unit Identification Code and by Personal Identifer.

3. The establishment of the job control number (JCN) by specific function key (which will call-up a pre-programmed format).

4. Data elements (such as modex, work unit code [WUC], work priority, work center assigned, and a plain language text of the complaint).

5. The sytem automatically enters the UIC, Aircraft Bureau Number (BUNO), type equipment code (TEC), JCN, TIME, and DATE.

6. In the work center, a hard copy printout is made (to be used by the assigned worker in that work center), and a copy is also made for quality assurance use.

7. Unique JCNs may now be recalled by authorized users (such as the Maintenance Control Officer or Maintenance Control Supervisor).

8. If the discrepancy requires repair parts or a repairable pool item for correction, the JCN data is recalled and modified as appropriate.

9. Error prompting and validation routine capability ensures that erroneous or improper data entries are corrected or discovered during the entry phase.

10. As the work center corrects the discrepancy, it requires a quality assurance representative to inspect and clear the JCN.

a. The Maintenance Control Officer and Maintenance Control C Supervisor would also be authorized to clear a JCN.

11. An aircraft would be returned to an up-status and cleared for flight when all the JCNs against that specific modex number have been cleared.

In summary, Figure 7 provides a view of the NALCOMIS organization and subsystem relationships. As it can be seen, the entire NALCOMIS Module 1 is a type of matrix organization with the outputs and inputs dependent upon each other and upon the external environment of upper level management. All levels of management are represented, as well as their relative position within the MIS structure.

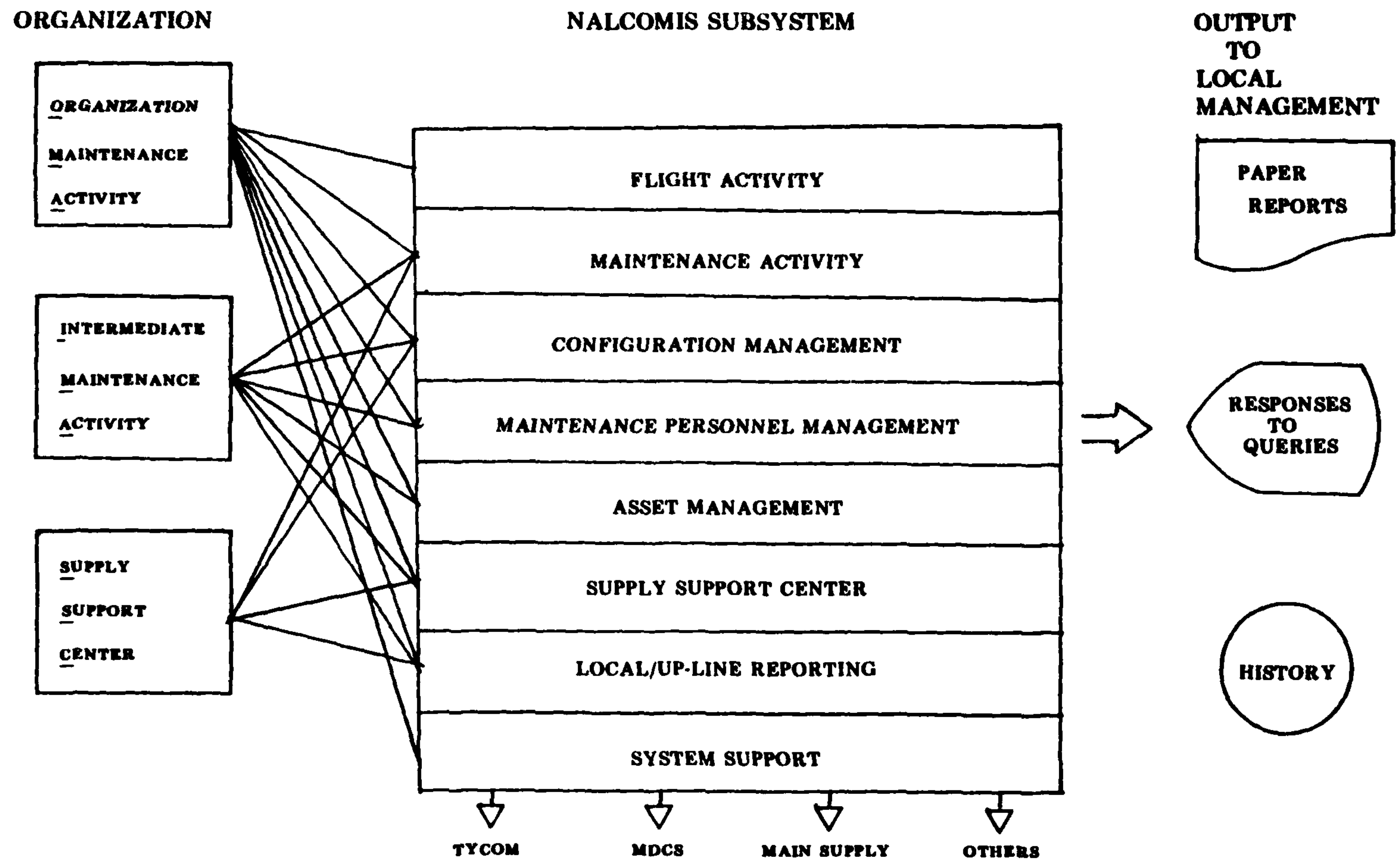


FIGURE 7: NALCOMIS ORGANIZATION/SUBSYSTEM RELATIONSHIPS. UP-LINE REPORTING OUTPUTS

A very generalized NALCOMIS system schematic of data flow is presented in Figure 8. The NALCOMIS data base managed by the DBMS is the key element in the entire flow.

Figure 9 depicts a generalized schematic of the NALCOMIS hardware system. A detailed description of the hardware requirements can be found in the PID-SNAP1-P2-001 of 17 August 1979. It is too detailed for further discussion in this thesis.

G. USER PERSONNEL

The Aviation Maintenance Managers at the OMA and IMA levels represent the local base management mentioned in the NALCOMIS ADS plan. Those managers include the first line supervisor through the OMA or IMA Maintenance Officer himself. Individuals are unique in their personalities, but positional responsibility held, (according to OPNAVINST 4790.2A, (Vol. I, Chapter 3) should be standard. This thesis addresses user personnel in aviation maintenance activities. Those positions and user responsibilities are described in detail in OPNAVINST 4790.2A (Vol. I, Chapter 3).

1. OMA Level Users.

- Aircraft Maintenance Officer .... Directly resonsible for the final accomplishment of the Maintenance Department mission.
- Assistant Maintence Officer...... Assistant head of the Maintenance Department.
- Maintenance Department Division Officer............... Division Officer functions set down in U.S. Navy regulations and directly serves under the Maintenance Officer.
- Quality Assurance Officer........ Aircraft Maintenance Officer, who holds the Quality Assurance Officer, directly responsible for the overall quality of maintenance performed by the department.
- Maintenance Control Officer .... Maintenance Control Officer, responsible to the Maintenance Officer for the control of the maintenance effort in the OMA.
- Material Control Officer .... Directly responsible to the Maintenance Officer for the Material Support Effort in OMA.

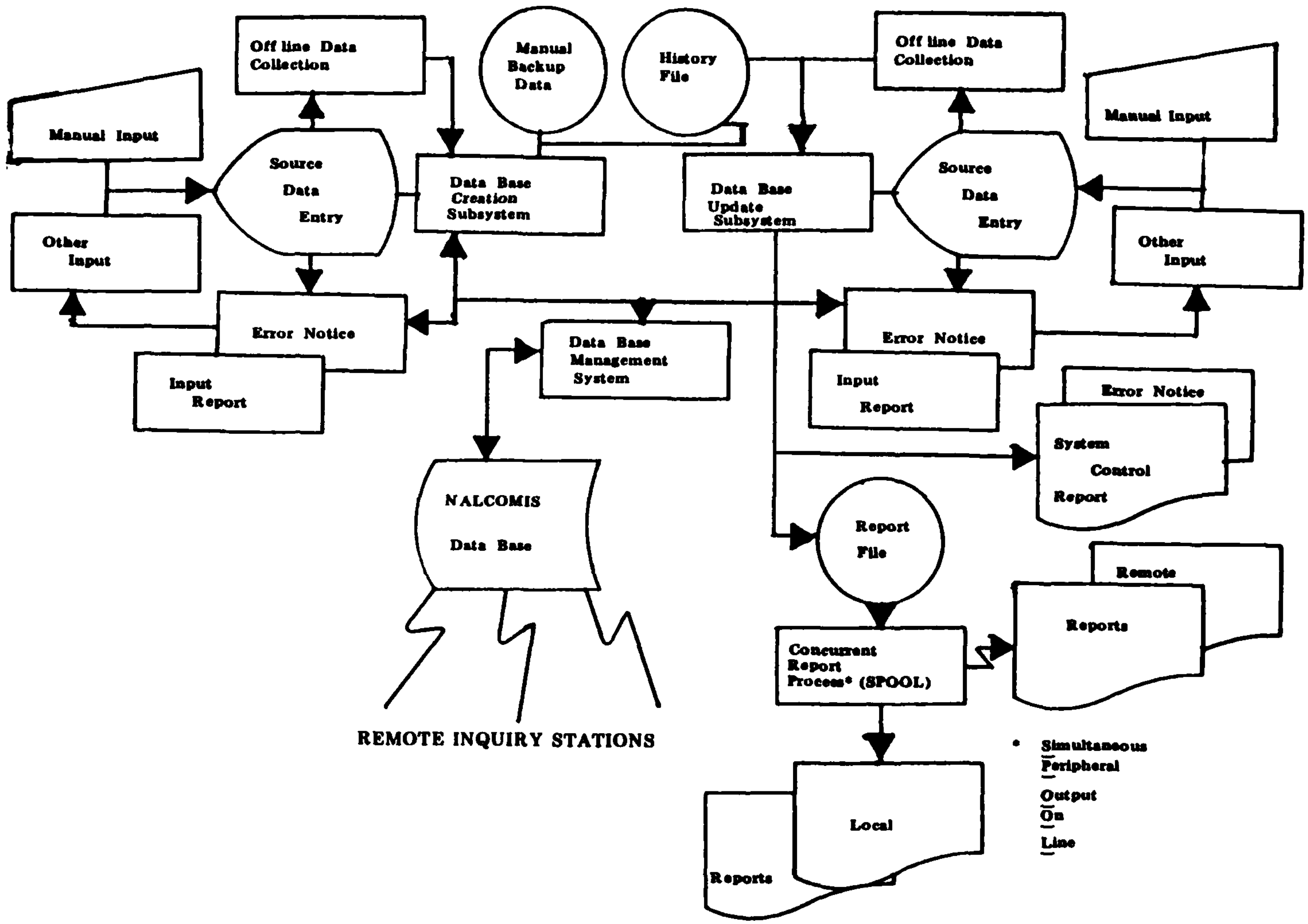


FIGURE 8: NALCOMIS SYSTEM SCHEMATIC
(Generalized Data Flow)

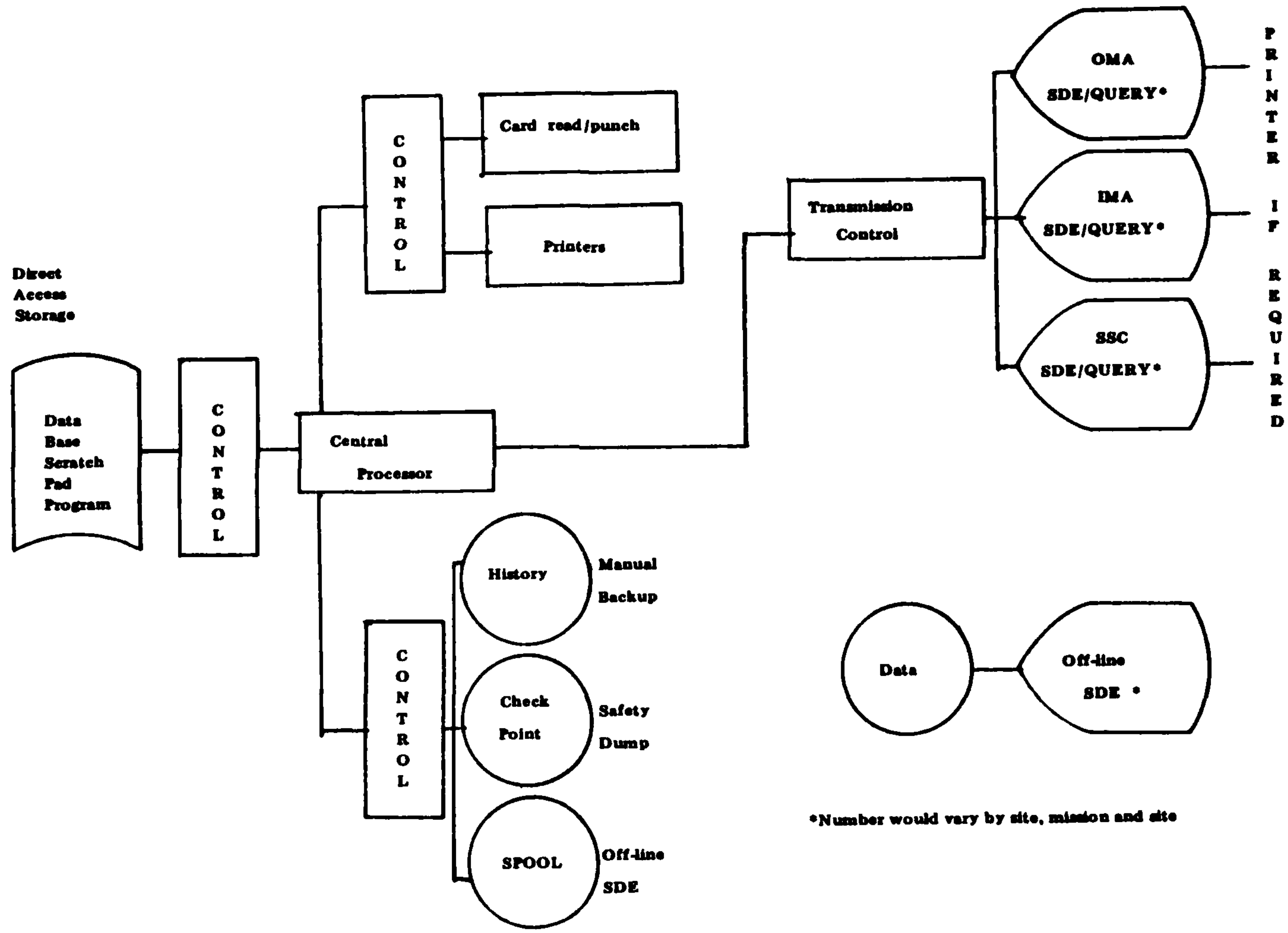


FIGURE 9: NALCOMIS SYSTEM HARDWARE SCHEMATIC
(Generalized)

- Analysis Division . . . . Directly supports the Maintenance Officer by providing qualitative and quantitative analysis information to assist him in continually reviewing the management practices within the department. The OMA analyst work center supervisor, is the key keeper and supplier of information and data.

- Work Center Supervisor . . . . Senior enlisted man who is the first line supervisor responsible in most cases for direct "hands on" equipment work, (tasked by the maintenance officer, his division officer and branch officer).

2. IMA Level Users.

- Intermediate Maintenance Officer . . . . Head of the Aircraft Intermediate Maintenance Department either afloat or ashore. He manages the department and is directly responsible to the Commanding Officer for the accomplishment of the department's mission.

- AIMD Maintenance/ Material Control Officer . . . . IMA Maintenance/Material Control Officer, who has prime responsibility for the overall AIMD productive effort and the material support of the entire department.

- AIMD Production Control Supervisor . . . . The senior enlisted supervisor directly responsible to the AIMD maintenance/ material control officer.

- AIMD Quality Assurance Officer . . . . The QA Officer, directly responsible to the AIMD Officer for the overall quality of maintenance performed by the department.

- AIMD Analysis Division . . . . Directly supports the maintenance officer by providing qualitative and quantative analysis information and assists him in continually reviewing the maintenance management practices and production within the AIMD. The AIMD analyst as work center supervisor, is the prime keeper and supplier of maintenance information and data.

- AIMD Division Officer . . . . Duties are set forth in U.S. Navy regulations; directly under the AIMD Officer.

The organizational structures of the OMA and IMA can be seen in Figures 10, 11, and 12. Department as a *term*, used throughout the functional descriptions, is a general term which applies to all aviation maintenance activities which have a department head. Divisions are assigned directly under departments and work centers are generally assigned by task within divisions. Some typical work centers would be the airframes shop, jet engine shop, etc. The work centers are limited by functional responsibility.

The OMA usually stays the same in structure whether it is ashore, at an NAS, or deployed. (See Figure 10.) The IMA's on the other hand are either structured for ashore support (see Figure 11) or afloat support (see Figure 12). Space restrictions, distance, location, mission tasks, and function determine the different structures.

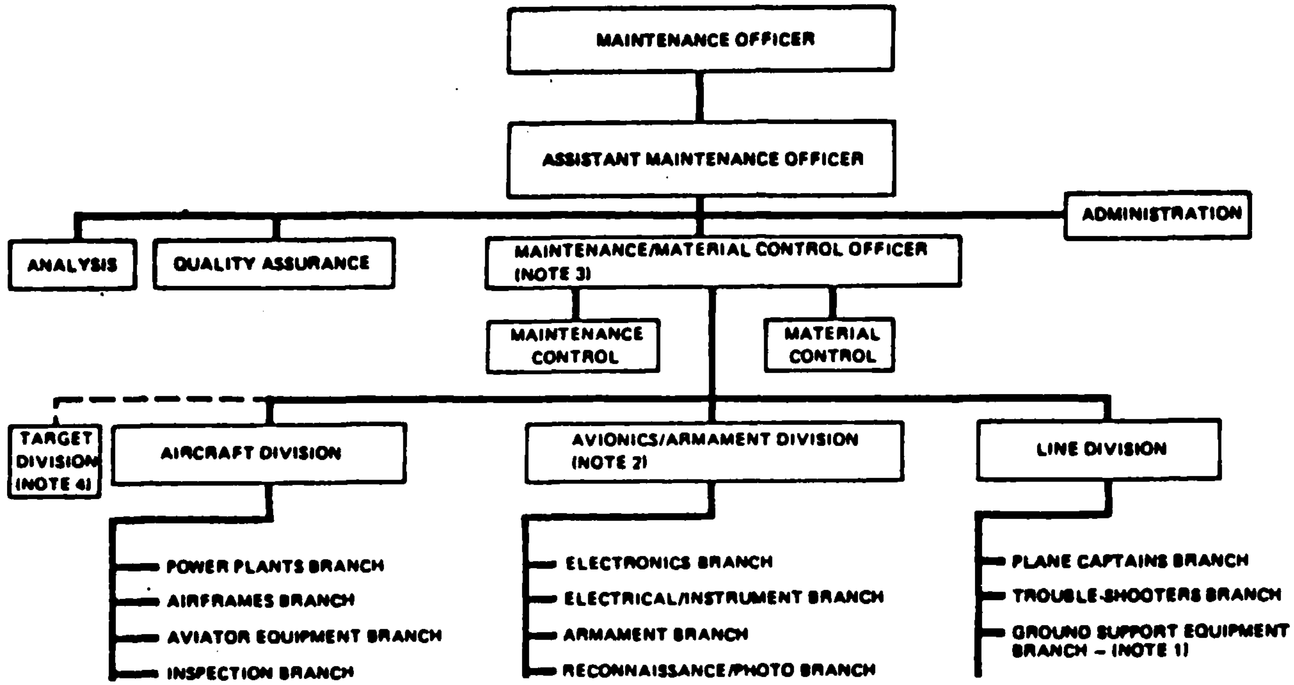
Some subtle difference in division officer responsibilities at the IMA ashore and afloat are worth noting. In the IMA afloat (AIMD) the Production Control Officer has prime responsibility for the total production effort of the AIMD. The AIMD division officer is not usually directly involved with his division's production effort, per se. However, in most cases ashore, the AIMD division officer is his own Production Control Officer, responsible for his division's production effort (e.g., the Power Plant's Division Officer is responsible for jet engine repair production).

The organizational structure noted here in Figures 10, 11, and 12, are composed of inter-related responsibilities which are present in the everyday accomplishment of aviation maintenance. To quote OPNAVINST 4790.2A,

> "These structures incorporate the basic span or control, the proper alignment of functions, the proper division of work, the homogeneity of assignments, and the delegation of authority commensurate with the assignment of responsibility."

H. SUMMARY

The purpose of this chapter was to present a background study of the NAMP, and NALCOMIS, of the potential NALCOMIS local management users, and to present an overview of the organizational structures of the OMA and IMA. By defining the purpose of the NAMP, and by describing the functions of NALCOMIS and the functions of present 3-M system MIS users, the impacts on users and organizational structure may be more easily seen



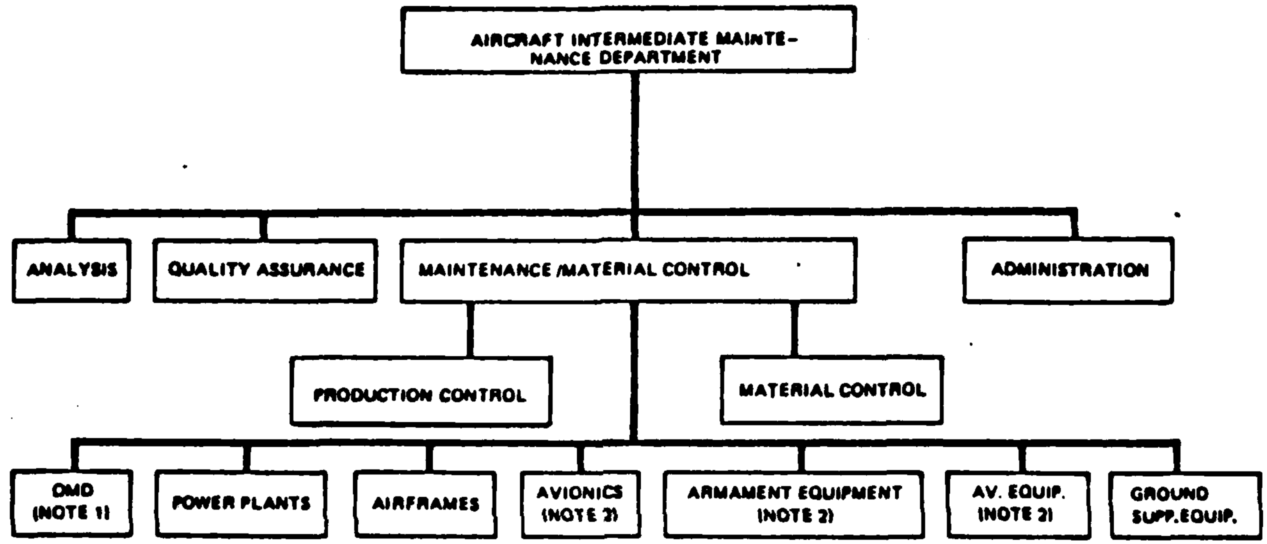
NOTE 1 . WHEN RESPONSIBILITIES RELATIVE TO OPERATION AND MAINTENANCE OF GROUND SUPPORT EQUIPMENT ARE EXTENSIVE, THE COMMANDING OFFICER WILL ESTABLISH A GROUND SUPPORT EQUIPMENT BRANCH UNDER THE LINE DIVISION TO COORDINATE AND/OR CARRY OUT ORGANIZATIONAL MAINTENANCE FUNCTIONS ON ASSIGNED SUPPORT EQUIPMENT.

NOTE 2 : IN MARINE CORPS ACTIVITIES THE AVIONICS AND ARMAMENT FUNCTIONS ARE SEPARATE DIVISIONS

NOTE 3 : IN MARINE CORPS ACTIVITIES THE MAINTENANCE/MATERIAL CONTROL OFFICER WILL HAVE A MAINTENANCE MOS.

NOTE 4 WHEN RESPONSIBILITIES RELATIVE TO THE OPERATIONS AND MAINTENANCE OF AERIAL OR SURFACE TARGETS ARE EXTENSIVE, THE COMMANDING OFFICER WILL ESTABLISH A TARGET DIVISION.

Figure 10: Organizational Level Maintenance Department Organization



BREAKDOWNS BEYOND THE BASIC DIVISIONS ARE NOT ILLUSTRATED BECAUSE OF THE GREAT VARIETY OF BRANCHES POSSIBLE. ACTIVITIES WILL BE REQUIRED TO ESTABLISH THE NECESSARY BRANCHES IN ACCORDANCE WITH THEIR INDIVIDUAL REQUIREMENTS. APPENDIX "D" (STANDARD WORK CENTER CODES) WILL BE USED AS A GUIDE TO ESTABLISH BRANCHES/WORK CENTERS WITHIN THE RESPECTIVE DIVISIONS. THE FOLLOWING GUIDELINES SHALL BE USED AS A BASIS:

(A) BRANCHES SHOULD BE ESTABLISHED ONLY WHEN MORE THAN ONE WORK CENTER IS INVOLVED, I.E., JET ENGINE BRANCH WITH WORK CENTERS FOR J-79 ENGINE AND J-52 ENGINE.

(B) WORK CENTERS SHOULD BE ESTABLISHED ONLY WHEN A MINIMUM OF THREE MEN PLUS A SUPERVISOR ARE REQUIRED TO OPERATE A SPECIFIC FUNCTIONAL AREA.

NOTE 1 : WHEN SPECIFIC AUTHORITY HAS BEEN GRANTED TO COMBINE THE OMD AND IMA, AN ORGANIZATONAL MAINTENANCE DIVISION WILL BE ESTABLISHED.

NOTE 2 : FOR MARINE CORPS ACTIVITIES, OFFICERS ASSIGNED TO THESE DIVISIONS HAVE GROUP DUTIES UNDER THE COORDINATION OF THE GROUP MAINTENANCE OFFICER.

Figure 11: Intermediate Level Maintenance Department Organization (ASHORE)

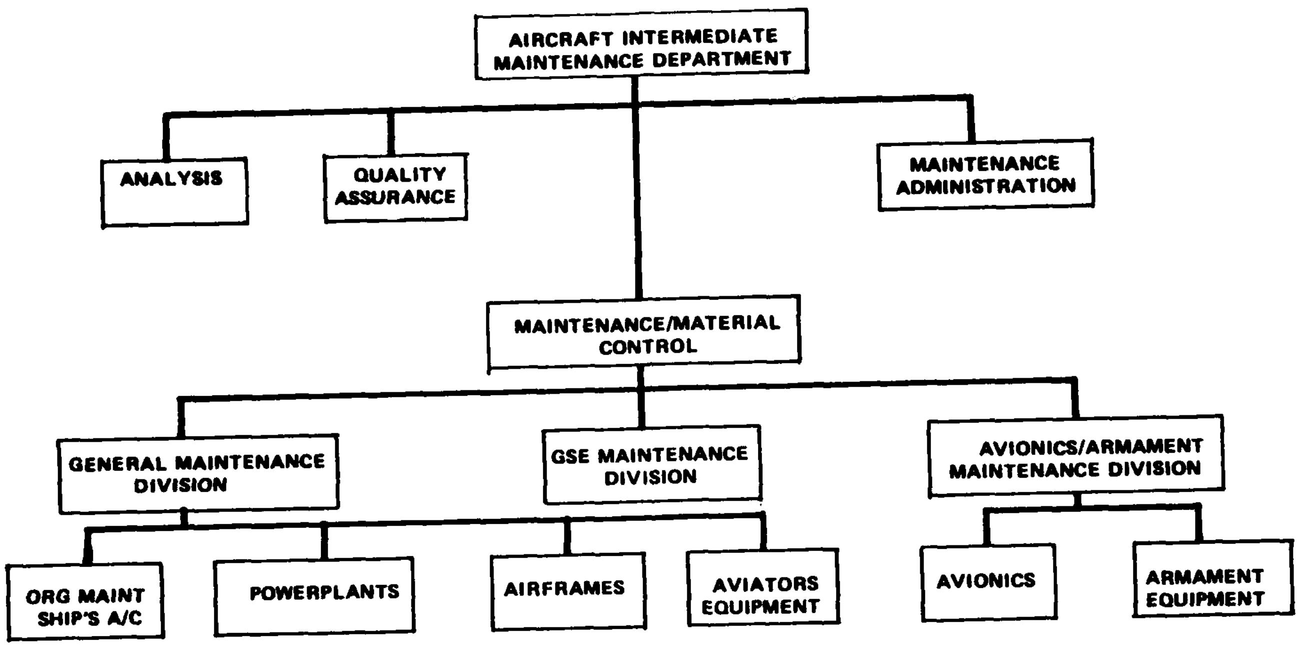


FIGURE 12: Intermediate Level Maintenance Department Organization (AFLOAT)

in the following chapter. Argyris (1971) notes the interrelations within organizations.

> "The idea is that the activity of any part of an organization has some effect on the activity of every other part. . . . therefore, in order to evaluate any decision of action. . . .it is necessary to identify all the significant interactions and to evaluate any decision of action. . . .it is necessary to identify all the significant interrelations and to evaluate their combined impact on the performance of the organization as a whole, not merely on the part originally involved."

There are some differences between Marine aviation maintenance and Naval aviation maintenance organizational structure. The differences will not be discussed here due to the limited scope of this thesis.

III. ANALYSIS OF OLRT-MIS IMPACT ON ORGANIZATIONAL STRUCTURE

Worthington (1974, p. 99) suggests that positive progress is being made in the application of computers and electronic data processing (EDP) in private and federal organizations. He describes the ultimate system as "the machine that can collect, organize, and store all existing data, then apply them both to conducting routine operations in an optimum way and to supporting management actions."

He further suggests that we have learned a great deal about desirable and undesirable applications, evolutions in advancing technological changes, and the resulting behavior changes which have resulted.

Kennedy and Hoffer (1978, p. 21-22) describe the difference between the newest OLRT-data processing systems and OLRT decision-making processes. The main thrust here is that behavioral problems are still a major factor in system design, implementation, and use.

NALCOMIS, which is an OLRT computer-based management system, cannot be expected to be immune to behavioral problems associated with its design, development, implementation, and use. The issue then is to consider people and their behavior. The aim of the project manager and his assistant should be to optimize the use of the computer system and the people.

> "...*if the optimal use of people and computing machines is considered jointly*, the most productive use of the combination generally implies less than optimum use of either taken alone." (Fahey, Love & Ross, 1969, p. 34.)

Project Managers (PM) of Management Information Systems, such as NALCOMIS, face difficult problems when the question of OPTIMAL utilization arises. The success or failure of the MIS and the PM is often a result of failing "to adapt the MIS to the people who will use it," (Fahey, Love & Ross, 1969, p. 34).

Fahey, *et al.*, (1969, p. 35) go on to reinforce the importance of behavioral considerations when managing the organization with computers.

"...The management of activities depends on a system of people, and if computer control of an activity is to be effective, the computer system must be modified to accommodate the art of managing people."

Often, an MIS fails because the reactions of the users were ignored or because the designers did not consider the impact of the MIS on the organization. "A technically elegant system is successful only if it is used...organizational factors are as important (or more so) than technological considerations in the design and operation of computer-based information systems," (Lucas, 1978, p. 59). Ein-Dor and Segev (1978, p. 1) support this and see MIS failures as a problem which is caused in the main by inadequate or improper management. They go on to suggest that management is still an art and not fully a science in its application in organizations. Fahey, *et al.*, (1969, p. 35) distinguish the distinction between managing of the art of interacting with people and of managing a science by controlling quantitatively measurable activities. They further argue that there is a distinction between "good art" and "good science" and the converse "bad art" and "bad science." This is to say "the application of sound judgment based on experience" and "the application of sound principles versus hunch or seat-of-the-pants decision making and the rush to apply cookbook solutions."

Organizations are made up of interrelated components which impact on one another and are impacted upon by their external environment, much as any other living, dynamic organism. This principle is often agreed upon by managers, but seldom practiced. Argyris (1971) describes this idea more succinctly.

> "The idea is that activity of any part of an organization has some effect on the activity of every part. .therefore, in order to evaluate any decision of action... it is necessary to identify all the significant interactions and to evaluate their combined impact on the performance of the organization as a whole, not merely on the part originally involved." (Argyis, 1971)

Taylor's finding (1972, p. 12) indicates that changes in the technical system of an organization cannot be made without "repercussions" in the social system. He supports the view of cultural anthropologists that changes in technology historically lean to more changes in behavioral attitudes, values and philosophies of people in organizations.

It follows then, that if technological changes inpact organizations and their members, the NALCOMIS project will impact its users, the aviation maintenance activities. Several issues will now be discussed so that the reader may acquire a better understanding of how and why behavioral aspects should be considered when designing, developing, implementing, and directing the use of an MIS, such as NALCOMIS.

A. ORGANIZATIONS AND THEIR STRUCTURES

What are organizations? They have been defined as "intricate human strategies designed to achieve certain objectives" (Argyris, 1971, p. 264). The operational environments, tasks, and goals of organizations vary so greatly that no single theory can describe organizations in specific terms. (Galbraith, 1973; Lawrence and Lorsch, 1967). There is, however, a single thread which appears to make some connection between different organizations. That common component is the structure of the organization.

> "Organization structure is concerned with the role and personnel arrangements within an organization that specify authority, co-ordination, and communication relationships. These arrangements link functions and physical factors to manpower requirements and availability. More simply, organization structure describes the internal system of social organizational operations actually are or should be accomplished." (Spector and others, 1976, pp. 3-1, 3-2)

Blau (1974) describes the two major structural aspects of organizations as formal and informal. The formal structure in the organization delineates the familiar authority interrelationships with their inherent characteristics of accountability and responsibility. The many procedures, regulations, and rules are the basis of hierarchial position for members of those organizations. Authority is a controlling dynamic, through which accountability and responsibility designate the "pecking order" in organizations.

Vertically structured organizations are configured in various layers to allow for many levels of authority and responsibility. Horizontally structured organizational activities have a limited number of levels for responsibility or control. We can see then that the function of formal structure is to provide for the division of labor, authority, and responsibility within organizations. Formal structure also serves to designate specific tasks to job titles and job descriptions.

Spector (1976, p. 3-2) describes four types of formal organizational structures in use by the military and business. The four basic types are:

- Line Structure — Emphasizing direct chains of command and authority.
- Line and Staff Structure — Encompasses a staff for information and advice to assist the line or operational elements.
- Functional Structure — Functional activity determines the divisions of responsibility.
- Matrix Organizational Structure — Functional groups assisting an authority which crosses departmental boundaries.

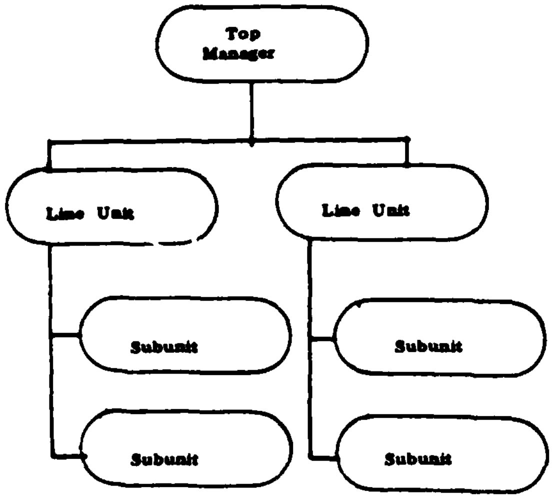
Figure 13 gives a clearer view of these four structural types of formal organizations.

The formal structure most closely resembling the aviation maintenance activities in Figures 10, 11, and 12 of Chapter II is the Line and Staff formal structure. The relationship between the superior and his subordinates, which exists both within the line and staff segments of the organization, is called the line relationship. It is that direct supervision that assigns work to subordinates and provides for their evaluation of performance. The staff relationship is that relationship between the "advisory" staff supervisor and "production" line supervisor. OPNAVINST 4790.2A (Vol. 1, 1977, p. 3-2) explains that:

> "Such staff elements as are incorporated in the organizational framework for maintenance activities are therefore designed to be integral elements of the organization, wholly concerned with the exercise of close servicing and supporting of production elements rather than concentrating on the exercise of prerogrative."

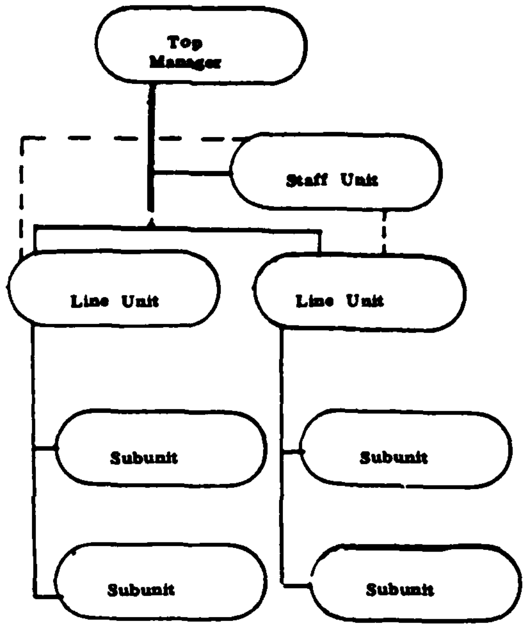
Simply stated, it follows that from the above, line has the preogative to make its own independent decisions, no matter what advice comes from the staff. However, the line has total and final responsibility for its decisions, whether or not it has been advised by the staff. The formal organizational structure of line-staff in aviation maintenance activities is the basic department, division, branch, and work center hierarchy. (See Figure 10, 11, and 12, Chapter II.)

A work center is established for each of the functional line areas. The NAMP provides that the quantity and designation of work centers be based on the specific location, schedules, span of control, number of personnel, and work loading in organizations. A key concern here is that provision is made for the lowest practicable level of management required to accomplish assigned and specific tasks.

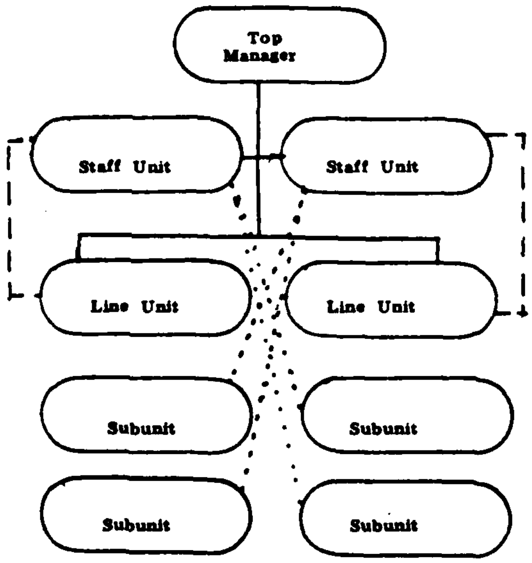


a. Line Organization Structure

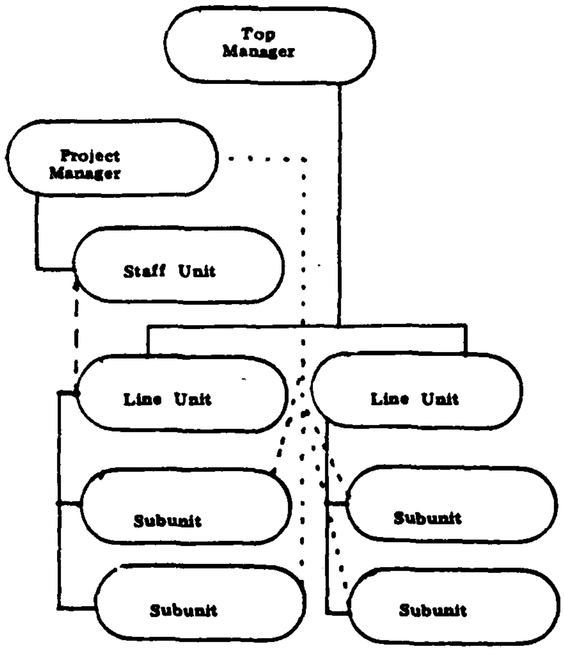
*KEY: —— Direct Authority
--- Advisory and Information
··· Functional Authority



b. Line and Staff Organization Structure



c. Functional Organization Structure



d. Project Manager Organization

FIGURE 13: TYPES OF FORMAL ORGANIZATIONAL STRUCTURE
(From Bureau of Naval Personnel, 1964)

In organizations there are interpersonal relationships of a dynamic nature which comprise the informal organizational structure. This is the unofficial structure which accounts for personal differences in leaders of organizations, managers at all levels within organizations, and at all supervisory levels. Regardless of the formal official organizational structure specified by regulation or edict, the informal organizational structure is the pattern of doing business within active organizations. One can see then that the formal structure is theory, whereas the informal structure is reality in organizations.

Spector (1976, p. 3-4) identifies five possible generic types of informal structure. It must be remembered that the variations of these structures may certainly be a infinite as the individual leaders of organizations. The five types of informal organizational structure are:

- Centralized Structure .... The flow of authority is from a single source at the top of the hierarchy.
- Consultative Structure........... The same flow of authority as centralized structure but encourages vertical communication from the staff through and to the line.
- Transactional Structure .... Vertical and horizontal communication, deliberation, and negotiation through all levels of the organization. Final decision authority is still top down.
- Partially Delegated Structure ..... This is management by negation. Staff types may, in fact, have some delegated authority for decision making. Decisions are made at lower levels.
- Decentralized Structure .... Full decision-making authority is delegated throughout the staff functions for guidance and direction to lower level line managers.

Blau (1974), and Genesky and Wessel (1964) all agree that the formal and informal organizational structures may not agree with each other in reality. We find that they support the idea that if an organization does business along the lines of the formal organizational structure but not exactly as officially prescribed, it can accomplish its assigned tasks effectively. However, if there is a great disparity between the two structures, there comes into play a dynamic restructuring in an effort to stabilize uncertainty and perceived chaos.

B. TECHNOLOGICAL INNOVATIONS IMPACT ON FORMAL AND INFORMAL ORGANIZATIONAL STRUCTURE

Naval organizations, which includes the aviation maintenance activities, have clearly defined formal organizational structures. The U.S. Navy Regulations, OPNAVINST 4790.2A and OPNAVINST 5100.2, officially delineate the authority, duties, and procedures required of these formal organizations. The fact has been confirmed that informal organizations also exist within the same organization at the same time. Since they are naturally interactive in their existence, each must be considered with the other. The impacts of the interaction and technological innovation has two major areas of concern:

1. The appropriate informal structure in situations of MIS introduction.
2. The formal structure in situations of MIS introduction.

The manual 3-M system, as it exists today, is a mixed pencil and paper, batch-processed, computer-based management information system. The methods and procedures followed have influenced and continue to influence the decision-making process at all levels of management within aviation maintenance activities and higher echelons, up to and including the Commander, Naval Air Systems Command Headquarters level. The local reports, upline reporting, and applicable publications only serve as guidelines for management decisions. Aviation maintenance managers at the OMA, IMA, and SSC levels have traditionally relied on past experience, peer assistance, and discussions with analysis staff personnel to assist them in making decisions about scheduling, work load, personnel assignments, etc. This *ad hoc* procedure of decision making results primarily from personality and the extent of group interaction (Spector, 1976, p. 3-7).

When advanced technology is introduced into an organization, as is the case of an OLRT MIS, the conventional methods in the decision-making process may be modified. These OLRT MIS have been defined by several researchers in the field.

> "An MIS is a system of people, equipment, procedures, documents, and communication that collects, validates, operates on, transforms, stores, retrieves, and presents data for use in planning, budgeting, accounting, controlling, and other management information systems as their purpose transcends a transaction processing orientation in favor of management decision-making orientation."
>
> (Schwartz, 1970, p. 28-31)

Moravec (1965, pp. 37-45) defines an MIS as "the procedures, methodologies, organization, software, and hardware elements needed to insert and retrieve selected data as required for operating and managing a company." While an MIS is described by Davis (1974) to be "...an integrated man-machine system for providing information to support operatives, management, and decision-making functions in the organization. The sytem utilizes computer hardware and software, manual procedures, management decision models, and a data base."

The previous definitions and descriptions are adequate but the element of behavior is not specificially addressed. Mason and Mitroff (1973) proposed that "an information system consists of at least one *person* of a certain *psychological type* who faces a *problem* within some *organizational context* for which he needs some *evidence* to arrive at a solution and that *evidence* is made available to him through some *mode of presentation*."

What is being proposed is not a total automated computer-controlled decision-making process. Rather, that the new technology, in the form of OLRT MIS, be a tool to augment the manager's expertise and amplify his capability to make the right decision in the allocation of scarce resources in the Naval aviation community.

The data base of an MIS stores, maintains, and updates information that applies to past occurences and other situationally-determined data, which could be determined data to be used in a present day problem-solving situation. Because the information is available for the most part in summary report format and, in the case of NALCOMIS real-time status reports, a decision maker is presented with an aggregated of the problem elements. This often aids in the decision-making process by removing some uncertainty. By combining the decision maker's personal expertise and the capability of the computer within an OLRT MIS, the quality of decisions and predictions is greatly enhanced.

C. OLRT-MIS IMPACT ON FORMAL AND INFORMAL ORGANIZATIONAL STRUCTURES

We have seen how a non-real-time MIS will affect the decision-making process and influence the formal and informal structures of organizations, so implementation of the

OLRT MIS may inpact the organizational structure for the decision-making process at all levels of management.

The impact on formal structures of implementing an OLRT MIS are acknowledged in Spector (1976, p. 3-8). The three formal structural aspects discussed include:

- the appropriate placement of the hardware elements of the OLRT MIS
- the assignment of new organizational roles within the formal structure
- the integration of computer hardware terminal operators into the formal organizational structure.

The NALCOMIS OLRT MIS project is to be implemented as an augmentation to the 3-M system MIS presently installed. There are no major provisions to change the formal organizational structure. Aviation Maintenance activities at the OMA and IMA levels are prohibited from altering their formal structure by OPNAVINST 4780.2A. Additionally, any approval for deviation from the prescribed structure must be requested from CNO via the chain of command (OPNAVINST 4790.2A, p. 3-2, Vol. 1).

Formal structure in the organizations is assumed then to be a constant. That is to say, no changes will be permitted, which means upper level management in those organizations have no authority to arrange the formal structure to achieve optimal performance when the OLRT MIS is implemented. With this as a contraint, formal organizational structures will be assumed to be constant in following discussions, and change impossible.

An opportunity exists, however, for combining the screening functions of the Aeronautical Material Screening Unit (AMSU) of the IMA and the Supply Screening Unit of the SSC into a single unit known as the Component Screening Unit (CSU). The screening functions involve non-RFI repairable components turned in by OMA/IMA activities for repair action, as well as screening functions involving RFI/BCM components received from IMA Work Centers. The CSU could be staffed jointly by maintenance and supply personnel. This merger of screening functions would in no way affect the responsibilities currently assigned to Production Control relating to workload scheduling and maintenance priority assignments.

All non-RFI components received by the CSU from the OMA/IMA activities would be processed by the system against the Individual Component Repair Listing (ICRL) generated by the host IMA. Results of such automated screening would enable the CSU to induct non-RFI repairable components into the IMA (via Production Control) or, if not repairable locally (BDM), arrange for such repair through INTER-AIMD support or DESIGNATED OVERHAUL POINT (DOP), as appropriate. Upon completion of repair by the IMA Work Center, the CSU would determine disposition of the returned component.

The following would be some possible responsibilities of the CSU:

- Receive non-RFI repairable components from OMAs/IMAs.
- Ensure all maintenance related records were with the component.
- Determine local IMA repair capability to accomplish required repair based upon the automated Individual Component Repair Listing.
- Inform Production Control of components ready for induction into the Work Center, whereupon Production Control assigns maintenance priority for work-load scheduling.
- When repair is beyond the Capability of the IMA, prepare documenation for shipment of non-RFI repairable components to a Depot Overhaul point, as a result of screening the Master Repairables Item List (MRIL), or to another IMA/Commercial Repair Facility, as appropriate.

Kanter (1972, p. 20-23) tells us that there are three prevailing schools of thought in regards to the impact of automation and computers on organizational structure. One school is the "futurists," who subscribe to the theory that the computer will cause the informal structure to become more centralized and wherein the formal structure would be changed to a pyramidal form. The second school of theorists Kanter calls the "traditionalists," who argue that, with the introduction of a computer system, there will be a move to a decentralized informal decision-making structure by allowing the decision making to be made at the middle-management and operating levels. Kanter's third group has no label but subscribes to the theory that there are no inevitable organizational impacts of introducing or implementing a computer based system. Computers for them neither impede nor facilitate a change in the organizational structure of decision making, either formal or informal.

Spector, *et al.*, (1976, p. 4-8) completed an extensive literature review of these schools of thought. A detailed bibliography of these theorists is present in Spector, *et al.*, (1976, p. 4-9). It will not be presented here for the sake of brevity.

Spector, *et al.*, (1976) found that the futurists felt that automation was pushing toward centralization and more hierarchical formal structures. Automation tended to minimize cost and efficiency and to change the relationship between managers and subordinates. This is because of greater impersonalization and objectivity in the decision-making process which reduces the amount of authority that may be delegated to lower levels of management. What in effect is predicted is the movement of middle management to a lower status and the loss of the decision-making functions. A result of that may be a sharper delination between upper level management and middle managers. Mann and Williams (1966), in a case study of the implementation of a computer system in a power and light company, found that while responsibility and authority increased during the implementation process conversion stage, the informal structure decentralized after the system became fully operational. They felt that more coordination from the upper levels of management and less teamwork were required, once the system was fully integrated into the organization. Wermuth (1972) predicted that a computer system would weaken the bureaucracy and bolster upper level leadership. His view considered the computer system information specialists as support personel only and didn't see them as a threat to those upper level managers.

The "traditionalist" approach reasons that, as a technological innvoation increases in complexity, the span of management control grows wider with lower levels of subordinates being given more responsibility and more delegated authority. This trend favors a more flexible decentralized decision-making structure. They also support the view that, as complexity increases, the formal structure begins to flatten. Lipstreu and Reed (1964, 1965) observed these phenomena between managers and subordinates in a baking plant. Group decision making becomes more prevalent and foremen were found with more responsibility and authority for tasks.

Looking at a military organization, Wilkinson (1965) found a more intimate interaction between the staff and managers when their evaluation, recommendation, and decision-making process was augmented by a computer system. The flow of communication observed prior to the installation of the MIS was vertical. After implementation it was observed that the informal decision-making structure began to move laterally, as well as vertically.

The third group of theorists identified by Kanter and Spector found that organizational structure was not impacted in any identifiable way. Gilman (1966) and Colbert (1974) found that computer system technology does not threaten the authority or existence of middle management; rather, that middle management will now have more time to devote to leadership, worker problems, motivation of workers, and to coordination functions. Gilman (1966) argues that computer systems need not change the structure of an organization but that it can reduce the manual paperwork aspects of middle-managers and supervisory positions and can make the accomplishment of assigned tasks significantly easier. This concentraction on lightening management's administrative burdens appears to be leading a trend away from the depersonalization which is prevalent in many modern institutional organizations. Management may be becoming more "people-oriented" and less "paperwork" driven.

Selleck (1971) and Dearden (1967) have observed that although a computerized MIS may tend to centralize the information in an organization, it did not centralize the authority and control. This supports the notion of MIS implementation with no change in organizational structure.

Spector, *et al.*, (1976) developed a contingency model of organizational structure in technological environments. (See Figure 14.) This was yet a fourth approach to explaining the impact of implementation of a new technology, (e.g., an OLRT MIS) on an organization's informal and formal decision making. This contingency model was designed as an expansion of ideas suggested by Simon (1965). His summarized view is quoted here.

> "Organizational form. . . must be a joint function of the characteristics of humans and their tools and the nature of the task environment. When one or the other of these changes significantly, we may expect concurrent modifications to be required in organizational structure. . . for example, in the amount of centralization or decentralization that is desirable."
>
> (Simon, 1965, p. 104)

Spector (1976, p. 4-4) determined that in order to determine effective and efficient organizational structures in technological environments, the contingency approach was required which would incorporate the numerous technological aspects of a particular situation. Additionally, it included the climatic conditions of the personnel interactions and the task mission conditions. Simply stated, the organizational structure, both formal and informal, will be impacted as a result of the situationality and interaction of the organizations task/mission, personnel (users), and the technology being introduced.

This model is descriptive and normative. It is descriptive in that it describes and predicts a profile of the organization in the context of operations and structures. It is normative in prescribing the organization structures that ought to be appropriate for a given situation.

This model was supported by its application to four OLRT MIS currently in use in the Navy. These systems were the:

- Combat Information Center's Naval Tactical Data System.
- USS KITTY HAWK Flagship Command Center, "Outlaw Hawk" MIS.
- Bureau of Naval Personnel (PERS4) AMIS MIS.
- Operation Control Center's Fleet Command Center MIS.

D. THE CONTINGENCY MODEL DESCRIBED

Figure 14 is the graphic representation of the contingency model of organization structure. Formal and informal organizational structure are contingent upon the organizational environment. This is a conceptualization which has interactive dimensions. These dimensions make up the climate of the organization.

- Mission/task
- Personnel
- Technology

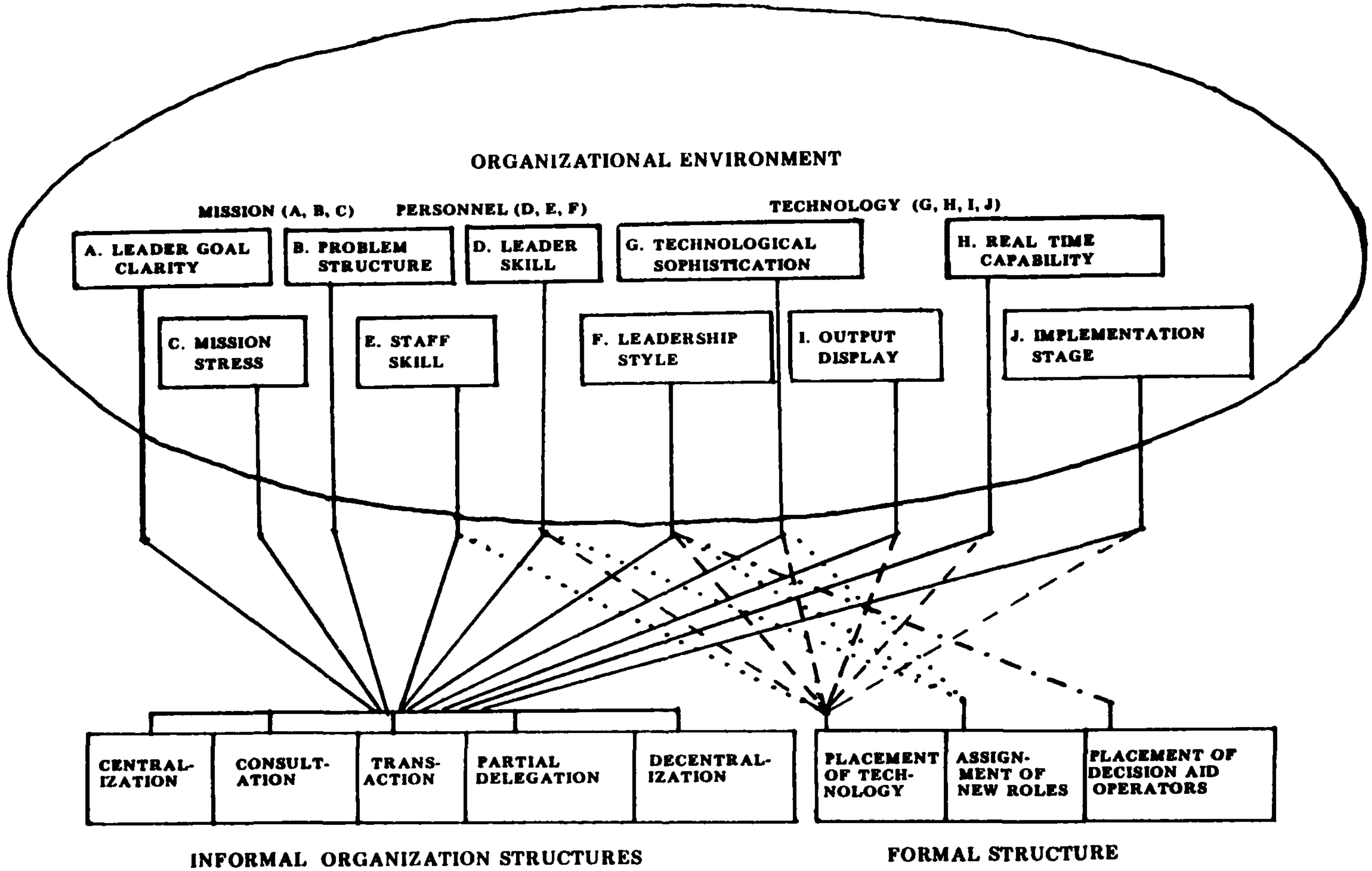


FIGURE 14: A CONTINGENCY MODEL OF ORGANIZATION STRUCTURE IN TECHNOLOGICAL ENVIRONMENTS (From: SPECTOR, *et al.*, (1976, p. 1-6).

The interactive component of the model is depicted by the ellipse. Those three dimensions are composed of 10 component variables:

- The mission/task climate .... 1. Leader goal clarity
  2. Problem structure
  3. Mission stress
- The Personnel climate .... 4. Leader Skill in technical and decision analysis methods
  5. Professional staff skill in technical and decision analysis methods
  6. Leadership style
- The Technology Climate .... 7. Technological sophistication
  8. Real-time capability
  9. Output display
  10. Technology implementation stage.

Table 1 is the list of contingency model assumptions described by Spector, *et al.*, (1976, p. 4-20, 4-1).

In our discussion of aviation maintenance activities and the implementation of NALCOMIS, the formal decision-making structure is assumed constant. The reasons were previously outlined in this chapter. Variations will be considered in informal structure variables, the task/mission variable, and the personnel variables. Since the NALCOMIS OLRT MIS hardware and software are to be standard throughout their application in the aviation community, they will only be of concern on initial implementation and held constant during the operation of the system.

The resulting impact on the informal structure of aviation maintenance activities, then, is contingent upon varied elements. The technology aspects are therefore considered an important element which heretofore has not been considered as a major disruptor of organizational structure by NALCOMIS planners. Organizational structures can be expected to change as a direct result of implementing an OLRT-MIS technology into an organization. Its initial structure and resultant organizational structure is contingent on the task/mission, personnel involved, and the technology introduced.

The BR-700 system (see Chapter II) evaluation showed definite changes in the informal organizational structure (Meher, 1979).

TABLE 1

The Impact of the Environment on Organization Structure: Contingency Model Assumptions

INFORMAL STRUCTURE ASSUMPTIONS:

1. Leaders who have clear mission goals are likely to prefer centralized, consultative, or partially delegated informal organization structures. Leaders who have ambiguous mission goals are likely to prefer transactional or decentralized structures.

2. Missions composed of well-structured problems are likely to appropriate in centralized or consultative informal organization structures. Missions with unstructured problems are likely to be appropriate in transactional, partially delegated, or decentralized structures.

3. Highly stressful missions are likely to be appropriate in centralized, partially delegated, or decentralized informal organization structures. Nonstressful missions are likely to be appropriate in consultative or transactional structures.

4. Leaders skilled in technical and decision analysis methods are likely to prefer centralized informal organization structures. Leaders that lack such training are likely to prefer consultative, transactional, partially delegated, or decentralized structures.

5. Staffs skilled in technical and decision analysis methods are likely to prefer consultative, transactional, partially delegated, or decentralized informal organization structures. Staffs that lack such training are likely to prefer centralized structures.

6. Leaders with relations-oriented styles are likely to prefer transactional, partially delegated, or decentralized informal organization structures. Leaders with task-oriented styles are likely to prefer centralized and consultative structures.

7. Analytical decision aids are likely to be appropriate in centralized or consultative informal organization structures. Inventory aids are likely to be appropriate in transactional, partially delegated, or decentralized structures.

8. Real time decision aids are likely to be appropriate in centralized, consultatiave, partially delegated, or decentralized informal organization structures. Non-real time systems are likely to be appropriate in transactional structures.

9. Large screen display units are likely to be appropriate in transactiona, informal organization structures. Individual terminal display units are likely to be appropriate in centralized, consultative, partially delegated, or decentralized structures.

10. Fully operational decision aiding systems are likely to be appropriate in centralized or consulative informal organization structures. Transitional systems are likely to be appropriate in transactional, partially delegated, or decentralized structures.

FORMAL STRUCTURE ASSUMPTIONS

A. Placement of the Decision Aids

   1. Leaders skilled in technical and decision analysis methods are likely to prefer pyramidal installations over divisional installations.

   2. Relations-oriented leaders are likely to prefer divisional installations over pyramidal installations.

   3. Analytical decision aids are likely to be appropriate in either pyramidal or divisional installations.

   4. Real time decision aids are likely to be appropriate in pyramidal installations, but not in divisional installations.

5. Large screen display units are likely to be appropriate in pyramidal installations, but not in divisional installations.

6. Fully operational decision aiding systems are likely to be appropriate in pyramidal installations, but not divisional installations.

B. Assignment to New Organizational Roles

1. Skilled leaders are likely to prefer training the existing staff.

2. Skilled staffs are likely to make it unnecessary to assign specially skilled personnel from outside the organization.

3. Relations-oriented leaders are likely to prefer training the existing staff.

4. Analytical decision aids are likely to make assignment of specially skilled personnel from outside the organization preferable, at least initially.

5. Fully operational decision aiding systems are likely to make training of the existing staff preferable.

C. Placement of Decision Aid Operators

1. Relations-oriented leaders are likely to prefer placing decision aid operators in a support status to existing functional personnel rather than in a new division of equal status with other divisions.

From: Spector, *et al.*, (1976, p. 4-21)

In the informal decision-making structure, there was a shift from a centralized structure to a transactional structure. The maintenance managers still held the power of negation but assumed more of a monitoring role in regards to their work center supervisors. The supervisors were now relieved of reporting to upper levels of management. Upper level managers had access to and used the real-time status reports to make operational decisions. They did not have to interrupt the supervisors during accomplishment of their tasks. "The supervisors had more time to supervise," (Meher, 1979). An unexpected benefit of the OLRT MIS implementation resulted in reducing the number of supervisory personnel as a direct result of the reduced administrative burden.

During the implementation of the SCEPTRE MIS at Republic Airlines, the management changed its decision-making structure to a more transactional structure from a partially-delegated structure. Upper level management did not now have to rely on middle management judgment in this field. It would make better management decisions because of the availability of real-time information, it previously had not had. The personnel component of this organization changed in that job descriptions and functions were modified to adjust for the reduction in manual clerical requirements. The numbers of personnel were not reduced; rather, they were better utilized and higher individual productivity was realized. Productivity was measured as a component of accuracy and system throughout. Middle management found itself in the position to be responsive to problems instead of reactive. Crisis management decision situations had been reduced by availability of accurate and time information in a usable format.

The FAMMS system experienced some difficulty in its implementation during the early stages (Barnes, 1979). Where upper level management became more deeply involved in the system and its mission in the organization, the implementation of OLRT MIS was completed successfully. The organization structure shifted from a partially delegated structure to one which was more transactional and somewhat consultative in nature. Upper level management awareness and support by using the system helped to ensure its success.

The SIDMS system seemed to shift the informal decision-making structure from a strong centralized structure toward the transactional informal structure. Middle managers, in the roles of production division officers, production control supervisors, and senior work center supervisors were allowed to make more decisions at their level without upper level management approval. The negation option was maintained but used less because progress was being monitored with real-time status reports. The SIDMS system provides the maintenance managers with production and status reports which were used to manage and control all repairable assets. The production output of all 20 AIMD workcenters was displayed along with the location of any component in the repair cycle. Additionally, the monitoring of high priority repairables was possible.

It becomes clear then that the contingency model can be applied to OLRT MIS and the resultant impact on informal organizational structure assessed. While all possible contingencies have not been discussed, it is sufficient to say that OLRT MIS do impact organizational structures in a significant manner.

Taking this analysis one step further then, we can see that OLRT MIS seem to drive informal organizational decision-making structures toward the transactional structure as described by Spector, *et al.* (1976). The OLRT MISs which were described earlier were analyzed in the context of the model. Since these OLRT MIS closely resemble significant portions of the NALCOMIS OLRT MIS, we should then expect approximately similar results.

The OMA level decision-making process can be expected to change during the implementation and operation of NALCOMIS. How it changes may be predicted by using the Contingency Model. The mission/task element of the model will vary depending upon the phase of the training-deployment cycle that the OMA is in. A squadron, an OMA activity, could be in its training phase where the actual combat mission stress could be considered less, e.g., a sortie missed due to a non-operational aircraft system does not become a life or death situation. On the other hand, the squadron (OMA) maintenance officer faces operational commitments to provide for aircrew training operationally ready aircraft while other

aircraft are being repaired by maintenance crews who themselves are in training. The maintenance officer's mission stress then could be assumed to be high. The OMA level managers are all under top down managerial pressure to perform. With NALCOMIS in operation, however, we can expect that lower level managers may have more perceived freedom to make real-time management decisions based on real-time local status reports. The maintenance officer should experience less stress due to his ability to provide the operations officer with up to date aircraft status in a timely manner. This should reduce the tension in scheduling aircrews to specific aircraft for training missions. The decision-making process structure should then be seen to merge into or close on the transactional structure described by Spector, *et al.*, (1976).

Because NALCOMIS is a technically sophisticated system with real-time capability to display status reports on CRT terminals, we can expect pressure to change the formal structure of the decision-making structure. Fewer work center supervisors may be required to monitor the work in process. A reduction in the number of work center suppervisors may be indicated as a result. However, a reduction in senior enlisted personnel should not be expected. The staff role of those senior enlisted personnel should become more important. The supervisor may now have a greater opportunity to give more, and more detailed, "hands-on" training and supervision to maintenance crews. Hopefully, this could result in the improvement of maintenance quality.

The previously mentioned changes as a result of implementing NALCOMIS could have other outcomes. If the maintenance officer or maintenance control officer's management and leadership styles are more autocratic in nature and less participative, we may not see a significant swing in the informal decision-making structure to the transactional mode. Based on Spector's predictions, we could expect that the NALCOMIS MIS may not be successfully implemented in that particular OMA. The users, which include the work center supervisors, may not support the system to the degree it requires for successful implementation and use. Work center supervisors, who in the past have been fairly autonomous in maintenance decisions at their level, may find themselves closely monitored by the maintenance control officer, who now has real-time information available. An autocratic style of

management coupled with NALCOMIS, which provides real-time information, could lead to top-down decision making (Centralized). The implementation strategy used by the NALCOMIS PM must certainly take this possibility into consideration during Phase I user training. Middle and upper level managers must be made aware of the consequences of using real-time status reports inappropriately.

The IMA managers face a different type of mission/task stress. Theirs is a supporting role once removed from actual "on-equipment" maintenance. However, the AIMD Officer is always under pressure while the airwing is attached to his ship or station to provide IMA level component repair. Using the contingency model, it becomes clear that the same kind of shifts in informal and formal decision-making structures can be expected when NALCOMIS is implemented in the IMAs.

The NALCOMIS PM should be aware of the situationality of the OMA/IMA activities before implementation. Shipboard activities, e.g., AIMDs and deployed squadrons which are on deployment, probably offer the ideal opportunity and most condusive situation for NALCOMIS implementation. OMAs and IMAs may be closer to the transactional mode of decision-making structure, or at least they may be more sensitive to NALCOMIS sytem implementation because of better internal and informal communication. This better communication is a direct result of working together for a period of about six months prior to deployment.

The impact of implementing NALCOMIS in an activity on a deployed status appears to be minimized during that time frame. On deployment, the trained aircrews and maintenance crews of the OMA and IMA are operating as a coordinated team. Combat mission stress may be greater, but managers in most cases have adjusted to it. They should have discovered who among their lower level managers and work center supervisors can be depended upon for accurate information when needed. As a result of this, the organizational environment may be more amenable for implementing an MIS. Shore activities may or may not be sensitive to training deployment cycles of airwings. It would seem, however, that the components of the contingency model would apply there also. The AIMD Officer and his lower

level managers have about the same responsibilities and functions as their sea-going counterparts. The significant difference between the deployable OMA/IMA and the non-deployable IMA activities is the civilian employee situation. Shore IMAs and SSCs depend on civilian workers for support. The labor-relations problems described by Bohannon (1978, p. 91) should be expected by the NALCOMIS PM. These problems will add yet another dimension to the implementation strategy.

In any case, deployed or ashore, the NALCOMIS implementation staff could use the contingency model to assist them in implementation planning.

E. SUMMARY

The decision-making structure of organizations and the impact of implementing computer technology (MIS) into them has been studied by several distinct groups of theorists. One group feels that organizational structures will tend to be more centralized after the introduction of this new technology. Another group reports just the opposite; it has found that structures tend to more decentralized as a result of the implementation of the technology. A third group reports that there will be no significant impact on organizational structure. The Spector, *et al.*, (1976) contingency model of organizational structure strongly supports the theory that the resultant impact on organizations will be situational in nature and could result in one of five informal and/or one of three formal structures. A study of four OLRT-MISs similiar to the NALCOMIS in the context of the contingency model shows what appears to be a trend toward the transactional form of informal decision-making structure with some overlap in partially delegated and consultative structures.

IV. CONCLUSIONS

> "Experience shows that a manager will eagerly use a computer in decision-making if it is fast, economical, and easy to work with."
>
> (Boulden & Buffa, 1970, p. 65)

The quote by Boulden and Buffa above serves to encourage this writer. Maintenance managers in aviation maintenance activities are the managers (users) in this quote. They have been the subject of this thesis. Their organizational decision-making structure has been one aspect of this research effort.

A. IMPLEMENTATION PLANNING

One writer views the implementation of the OLRT MIS such as NALCOMIS as a less than advantageous experience for an organization. (Chapman, 1965, p. 64).

> "While there are many advantages to the real-time system, there are also disadvantages which must be considered. Of the disadvantages one must consider the organizational upheaval and the power struggle that may be generated by the men who control and understand computers. Thus the working relationships and job content which may be drastically change loom as major disadvantages, *but even these disadvantages, can be overcome in time.*"
>
> (Chapman, 1965)

The purpose of the discussion in the previous chapters has been to minimize that time to overcome the possible organizational disadvantages of implementing an OLRT MIS, NALCOMIS, and to maximize the probability of making that implementation successful.

Bohannon and Allison (1978) reported that the "installation of a new or substantially revised supply and. . . control system is a traumatic experience." The reader has seen in previous chapters the impact on formal and informal decision-making organizational structure of implementing an OLRT MIS. The new system will substantially change the way daily business is carried out and how long range planning is accomplished. Performance measures for personnel and organizations will change and be evaluated against different standards. In addition, it is evident that new patterns of communication and discussion between all levels of management will evolve during the implementaiton of a new system.

Since NALCOMIS will be implemented Navywide among aviation maintenance activities, and the environment of each activity is different, no one single implementation strategy will be recommended in this thesis.

The NALCOMIS project management team has many options to choose from for planning a particular implementation strategy. Alter and Ginzberg (1978) have suggested a model of risk factors which might serve to use a "risk-reducing strategy" for implementation. (See Table 2.) As an example, consider the risk of having a non-existent or unwilling user. This would be a problem encountered during the initial stages of implementation. Table 2 shows that three strategies are possible which might minimize this problem: obtaining user commitment, and selling the system. Alter and Ginzberg (1978) indicate in their study that these strategies would best be initiated during the scouting or design stage of MIS development. These choices should be made here because decisions must be made concerning key people who will work on the MIS and the organizational starting point for the project. Alter and Ginzberg go on to stress that the reporte between users and the establishment of the "right contacts" for the project is important to obtain user participation and to have a willing "buyer" for the system. They further state that without this base it is possible that the project would continue with no potential user involvement.

Each stage of the total MIS development and implementation has its own "risk-factors" (see Table 3) which can be minimized by instituting a compensating or inhibiting strategy.

Chapter III of this thesis described the contingency model for organizational structure in technological environments. It showed that changes in the organizational environment can impact the structure of the organizational decision-making structure. This should be considered when implementing the OLRT MIS. By relating the other OLRT MIS to the model, it was apparent that the closer an organization's decision-making structure was to the transactional structure of the contingency model, the more likely its chances of success.

B. SOME POSSIBLE IMPLEMENTATION OPTIONS

At this point, the project manager must ask himself the question of when to implement the OLRT MIS into an organization. That is to say, should he do it when the organizational structure is in other than the transactional structure, or should he wait until the organizational situation is more conducive to MIS implementation? In most cases, the project manager will not have the luxury of waiting for the "right time" when implementing systems in aviation maintenance activities.

TABLE 2

Risk-Reducing Strategies

Risk Factor: / Risk-Reducing Strategies	Designer lacking experience	Nonexistent or unwilling user	Multiple users or designers	Turnover	Lack of support	Unspecified purpose or usage patterns	Unpredictable impact	Technical and cost-effectiveness problems
Use prototypes	C					C	I	I
Use evolutionary approach	C					C	I	I
Use modular approach	C					C		I
Keep the system simple	C							I
Hide complexity		C*						
Avoid change		C**						
Obtain user participation		I	C***		I	I	I	
Obtain user commitment		I	C		I			
Sell the system		I+			I		C+	
Provide training programs			C	C		C		
Provide ongoing assistance				C				
Insist on mandatory use*		C++						
Permit voluntary use+++		C	C		C			
Rely on diffusion and exposure+++		C	C		C			
Tailor system to people's capabilities		'	C					

C = Compensating Strategy

I = Inhibiting Strategy

* Inconsistent with general requirements of participative approach to development.

** May imply inability to develop important, interesting systems.

*** Very difficult in practice.

\+ Can backfire if system is oversold.

++ A strategy of last resort, violating the basic tenets of the participative model.

+++ These are not really actively pursued strategies; they represent passive resignation in the face of difficulties.

TABLE 3

Risk Factors at Each Stage of Implementation

Table 3 Risk Factors at Each Stage of Implementation

Stage	Risk Factor	Process Failure	or	Contributing Factor
Scouting	Designer lacking prior experience with similar systems.	•		
Entry	Nonexistent or unwilling user.	•		
	Multiple users or designers.			•
Diagnosis	Turnover among users, designers, or maintainers.			•
	Lack of support for system.	•		
Planning	Inability to specify purpose or usage patterns in advance.	•		
	Inability to predict and cusion impact on all parties.	•		
	Technical problems, cost-effectiveness issues.	•		
Action				
Evaluation				
Termination				

Therefore, this writer recommends that if the PM does not have a choice as to when to implement a system, then he should exploit the advantage of organizational structure. The project manager has organizational development tools available for his use as well as the organizational development resources. These are in the form of the human resource management centers (HRMC) and the human resource management (HRM) survey. When the 3-M system for surface ships was implemented at the Naval Station Pearl Harbor, Hawaii recently, the HRM survey was used to determine the command climate. With this in hand, the commanding officer's staff was able to implement the system successfully and in a timely manner. Several indexes possible and of concern to the NALCOMIS PM would be:

COMMAND CLIMATE DIMENSION

- Communications Flow Index . . . . .Command leadership understands the work and problems of the command. Information flows freely through the chain of command, from the work groups to a listening and responsive leadership, and to the work groups concerning plans and problems facing the command.

- Decision-making Index . . . . .Information is widely shared within the command, and decisions are made at those levels where the most adequate information is available. Supervisors seek out information before making decisions.

SUPERVISORY LEADERSHIP DIMENSION. . . . . .The behavior of supervisors toward subordinates.

- Support Index. . . . . .Leaders behave in a way which increases the work group member's feelings of worth and dignity.

PEER LEADERSHIP DIMENSION. . . . . .Behavior of work group members toward one another.

WORK GROUP PROCESS DIMENSION. . . . . .Measurement is made of those things which characterize the group as a team and whether group members work together well or poorly. The way in which group members share information, made decisions, and solve problems determines the group's productiveness and the quality of its outputs.

The above monitored indexes and dimension measures are those aspects which should interest the PM in regard to one aspect of his strategy for implementing the OLRT MIS. The PM could coordinate with the designated NALCOMIS project officer in each aviation maintenance activity, the HRMC for the area, the activity commanding officer and the fleet material support office personnel. The HRM survey would be administered to an activity to measure the required indexes, the command climate determined, and a mutually agreed upon implementation strategy planned for that particular activity.

The NALCOMIS Project Manager and his staff should be prepared to monitor several critical areas during system implementation. This thesis has touched on some of the key issues. A detailed list of all areas would be impossible due to the infinite situational variables possible. However, some possible areas of major concern are listed here to provide some assistance.

- Formal Designation of a NALCOMIS Project Officer. A Project Officer must be formally designated to be the single point of contact for the OMA/IMA activity. Failure to do so may result in conflicting guidance and direction leading to misunderstanding on the part of all concerned.

- User Control. Detailed user procedures must be developed by the OMA/IMA activity prior to and during implementation. Particular attention should be devoted to input/output document flow and exception processing. Failure to do this may result in a system out of control, requiring an additional reconciliation of records.

- Management Commitment. Top management must be totally committed to the training, implementation, and operation of the sytem. Failure to communicate this attitude from the Maintenance Officer on down to the Work Center Supervisors may result in further conflicts and misunderstanding that can lead to user resistance to the system.

- Training. Personnel from the IMA/OMA user activity should be designated to provide future refresher training to all operator personnel. This is required to counteract the high turn-over of personnel in these type activities. Phase I and II type training should be conducted about two weeks apart. Management training of the Maintenance Officer, Maintenance Control Officer and other Officers in the Maintenance Department should also be done in a similiar manner. Managers unfamiliar with the types of status reports available may not use them.

- Navy Enlisted Codes. Personnel assignments are not always made with regard to individual Navy Enlisted Classification. This would indicate the possibilitiy of some enlisted personnel not being fully cognizant of the mission and operational requirements of the unit to which they are assigned.

- Civil Service Employees. At small and medium-sized Naval Air Stations, many civilians are employed through out the Supply Department and the ADP support facilities.

Unless these civilian personnel are made aware from the beginning of implementation of what changes are to be made and basically how these changes will affect the individual civilian worker, conflicts and user resistance can be expected.

- Terminal Location. The location of the remote terminals and printers is not as complex as the placement of the central computer hardware. The main consideration in determining their location is the selection of central locations in the work centers that are easily accessible to all personnel who must utilize them. Placement of a terminal for use by upper level management, e.g., the Maintenance Officer, is an aspect worth considering.

Preparedness of the OMA/IMA activity is a critical factor in the success of the system implementation. Through meticulous planning and diligent execution of milestone tasking, the complete readiness of an activity should be assured. However, the variability of personalities and activities should always be kept foremost in mind. Although the OMA and IMA activities are basically structured in accordance with the NAMP, actual unit operating procedures and policies are established by the current Commanding Officer, Division Officers, and Chief Petty Officers. Consequently, operations, administration and reporting techniques will vary from activity to activity and quite possibly from division to division within the same activity.

C. SUMMARY

It has been shown in this thesis that technology in the form of an OLRT MIS can impact the decision-making structure of organizations. The assumption was then made that NALCOMIS may impact the aviation maintenance activities in which it is implemented. Through the use of the contingency model, it was shown that when an organization's informal decision-making structure was most like the transactional structure, the likelihood of successful implementation and use of the MIS was high.

The use of "risk factor strategies" was suggested as a possible method to plan the implementation strategy, since all aviation maintenance activities had different organizational situations and environments. The HRM survey and the HRMC was suggested as possible tools to help the NALCOMIS PM determine the state of a candidate organization prior to implementation. This determination would be useful in the planning of a possible implementation strategy "tailored" to that specific organization.

The implementation of an OLRT MIS into an organization is a complex problem both technically and psychologically. This study is by no means the ultimate answer to the magnitude of questions facing the NALCOMIS Project Manager. Rather it has been an attempt to heighten the PM's awareness of the "people" problems he may encounter and to assist him in overcoming them. While successful implementation can never be guarenteed, perhaps its impact on organizations can be minimized.

APPENDIX A

GLOSSARY/ACRONYM LIST

ACE	Aircraft Conditional Evaluation
A/C	Aircraft
ACFT	Aircraft
ADMRL	Application Data Material Readiness List
ADP	Automated Data Processing Automatic Data Processing
ADS	Automated Data System
AECL	Aircraft Equipment Configuration List
AESR	Aeronautical Equipment Service Record
AIMD	Aircraft Intermediate Maintenance Department
AIRLANT	Air Forces, Atlantic Fleet
AIRPAC	Air Forces, Pacific Fleet
AKØ	Project Code for Not Operationally Ready Supply
AK7	Project Code for Capability Impaired for Lack of Parts
AMMR	Aircraft Maintenance and Material Readiness
AMMRL	Aircraft Maintenance and Material Readiness List
AMEN	Aviation Maintenance Engineering Analysis System
AMP	Analytical Maintenance Program
AMSU	Aeronautical Material Screening Unit
ANFE	Aircraft Not Fully Equipped
ANORS	Anticipated Not Operationally Ready, Supply
ANSI	American National Standards Institute
AN/UYK-5	Standard Navy Shipboard Computer
AOC	Aircraft Operational Capability
ARPANET	Advanced Research Projects Agency Network
ARSSS	Automated Ready Supply Stores System
ASCII	American Standard Code for Information Interchange

ASD	Aircraft Statistical Data
ASMRA	Adjustment Scheduled Maintenance through Reliability Analysis
ASO	Aviation Supply Office
AVCAL	Aviation Consolidated Allowance List
AWM	Awaiting Maintenance
AWP	Awaiting Parts
baud	A unit of signaling speed usually equal to one bit per second
BCM	Beyond Capability of Maintenance
bit	a binary digit
BUNO	Bureau Number (Navy Aircarft Number)
Burroughs B-3500	Burroughs Corporation Medium Size Computer
byte	Sequence of bits, usually eight
CAMSI	Carrier Aircraft Maintenance Support Improvement
CDC 3600	CDC Medium Sized Computer
CHNAVMAT	Chief of Naval Material
CLAMP	Closed LOop Aeronautical Management Program
CMC	Commandant of Marine Corps
CNA	Center for Naval Analysis
CNAP	Commander Naval Air Force, Pacific Fleet
CNM	Chief of Naval Material
CNO	Chief of Naval Operations
COBOL	Common Business Oriented Language
CODASYL	Conference on Data Systems Languages
COG	Cognizance Symbol
COMNAVAIRLANT	Commander Naval Air Force, Atlantic Fleet
COMNAVAIRPAC	Commander Naval Air Force, Pacific Fleet

CONUS	Continental United States
COSAL	Coordinated Shipsboard Allowance List
CPU	Central Processing Unit
CRT	Cathode Ray Tube
CV	Aircraft Carrier
DBMS	Data Base Management System
DD-1348	DOD Single Line Item Requisition
DD-1348m	Supply Requisition
DED	Data Element Dictionary
DMS	Data Management System
DoD or DOD	Department of Defense
DODI	Instruction Issued by the DoD
DON	Department of the Navy
DP	Data Processing
DPSC	Data Processing Service Center
DSA	Defense Supply Agency
DSC	Data Service Center
EAM	Electronic Accounting Machine
EMT	Elapsed Maintenance Time
EOQ	Economic Order Quantity
ESD	Equipment Statistical Data
ETR	Engine Transaction Report
EU	End Use
FAGLANT	Fleet Assistance Group, Atlantic
FAGPAC	Fleet Assistance Group, Pacific
FAMMS	Fixed Allowance Management and Monitoring System
FG	Family Group
FH	Flight Hours

FLT	Flight
FMSO	Fleet Material Support Office
FORCES	Fleet Oriented Review Committee Evaluating NALCOMIS Fleet Review Committee Evaluating SACOMIS (old)
FRAMP	Fleet Replacement Aviation Maintenance Personnel
FREDS	Flight Readiness Evaluation Data System
FY	Fiscal Year
GSE	Ground Support Equipment
GSED	Ground Support Equipment Statistical Data
IBM 360	IBM Computer Family
IBM 407	IBM Punched Card Accounting Machine
IBM 1401	Small (older) IMB Computer
ICRL	Individual Component Repair Listing
ICP	Inventory Control Point
IFAR	Individual Flight Activity Reporting
IFARS	Individual Flight Activity Reporting System
ILS	Integrated Logistics Support
IMA	Intermediate Maintenance Activity
IMRL	Individual Material Readiness/Requirements List
I/O	Input/Output
IOC	Initial Operational Capability
IOU	I Owe You
IRAM	Improved Repairables Asset Management
IW	In Work
JCN	Job Control Number
JD	Julian Date
LFA	Lead Field Activity
LHA	Amphibious Assault Ship, General Purpose

LOR	Level of Repair
LPH	Amphibious Assault Ship
LPM	Lines Per Minute
M	Million (mega)
M-sec	One Millionth of a second - Micro-second
3-M	Maintenance and Material Management System
MAF	Maintenance Action Form
MAG	Marine Aircraft Group
MAR	Maintenance Action Record
MARES	Marine Corps Automated Readiness Evaluation System
MAW	Marine Aircraft Wing
MC	Maintenance Control
MCAS	Marine Corps Air Station
MCO	Maintenance Control Office
MCRL	Master Component Repair Listing
MDCS	Maintenance Data Collection System
MDR	Maintenance Data Report
MEASURE	Metrology Automated System for Uniform Recall and Reporting
MESL	Mission Essential Subsystem List
MFC	Multiple File Concept
MGMT	Management
MHA	Manhour Accounting
MIL—STD	Military Standard
MILSTRAP	Military Standard Transaction Reporting and Accounting Procedure
MILSTRAP	Military Standard Transaction Reporting and Accounting Procedure
MILSTRIP	Military Standard Requisitioning and Issue Procedure

MIS	Management Information System
MMM- (3-M)	Maintenance and Material Management System
MODEX	Aircraft Side Number
MR	Material Reporting
MRC	Maintenance Requirement Card
MRIL	Master Repairable Item List
MSDO	Management System Development Office
MSG-2	Maintenance Steering Group, Airline Maintenance System Policies
MSOD	Maintenance Support Office Department (Mechanicsburg, PA)
MSSLL	Master Stock Status and Location Listing
MTTR	Mean Time to Repair
N	Billion - NANO
N-sec	One Billionth of a second — NANO-second
NAILSC	Naval Air Integrated Logistic Support Center
NALCOMIS	Naval Aviation Logistics Command Management Information System
NALDA	Naval Aviation Logistics Data Analysis
NAMP	Naval Aviation Maintenance Program
NARF	Naval Air Rework Facility
NAS	Naval Air Station
NATOPS	Naval Air Training and Operating Procedures Standardization
NAVAIR	Naval Air System Command
NAVAIRINST	Instruction Issued by Naval Air System Command
NAVCOSSACT	Naval Command Systems Support Activity
NAVMAT	Naval Material Command
NAVMATINST	Instruction Issued by the Naval Material Command
NAVMMACPAC	Naval Manpower and Material Analysis Center, Pacific
NAVSAFCEN	Naval Safety Center

NAVSUP	Naval Supply System Command
NALC	Naval Electronics Laboratory Center
NFE	Not Fully Equipped
NIS	Not in Stock
NORM	Not Operationally Ready, Maintenance
NORS	Not Operationally Ready, Supply
NRFI	Not Ready for Issue
NSN	National Stock Number
OCR	Optical Character Reader
OMA	Organizational Maintenance Activity
O&MN	Operations and Maintenance, Navy
OPNAV	Office of the Chief of Naval Operations
OPNAV Form 3760/2	Naval Aircraft Flight Record
OPNAVINST	Instruction Issued by the Chief of Naval Operations
OPTAR	Operating Target Budget Report
OSD	Office of the Secretary of Defense Operational Sequence Diagram
OT&E	Operational Test and Evaluation
PCAM	Punched Card Accounting Machine
PIN	Pool Item Number
PME	Precision Measuring Equipment
P/N	Part Number
QA	Quality Assurance
RAMS	Readiness Activity Management System
2R Cog	Navy Aviation Supply Office Cognizance Symbol for Repairable or Investment Type Material
REVAMP	Review, Revitalize and Restructure the Aircraft Maintenance Program
RFI	Ready for Issue

RFP	Request for Proposal
RPG	Report Generator
RMC	Reduced Material Condition
RQN	Requisition
RS	Readiness Status
SACOMIS	Shipboard Aviation Command Management Information System
SAF	Support Action Form
SCIR	Subsystem Capability Impact Report
SDA	Source Data Automation
SDE	Source Data Entry
SDLM	Standard Depot Level Maintenance
SECNAVINST	Instruction Issued by the Secretary of the Navy
SHARP	Serialized High Cost Asset Reporting System
SHIPMIS	Ship Management Information System
SMIS	Ship Management Information System
SOCIDAB	Site Oriented Centralized and Integrated Data Base
SP	Stock Point
SPCC	Ship's Parts Control Center
SQD	Squadron
SRC	Scheduled Removal Component (OPNAV Form 4790/28A)
SRS	Supply Response Section
SUADPS	Shipboard Uniform Automated Data Processing System
SUADPS-EU	Shipboard Uniform Automated Data Processing System - End Use
SUP	Supply
SVCS	Services
SYS	System
SYSCOM	System Command
TAT	Turn Around Time

TDC	Technical Directive Compliance
TDCF	Technical Directive Compliance Form
TDSD	Training Device Statistical Data
T&E	Test and Evaluation
TEC	Type Equipment Code
TECH	Technical
TECHEVAL	Technical Evaluation
TIR	Transaction Item Reporting
T/M/S	Type/Model/Series
TYCOM	Type Commander
U-1500	UNIVAC 1500 Model Computer
UADPS	Uniform Automated Data Processing System
UADPS-NAS	Uniform Automated Data Processing System - Naval Air Station
UADPS-SP	Uniform Automated Data Processing System - Stock Point
UIC	Unit Identification Code
VAMOSC	Visibility and Management of Support Costs
VAST	Versatile Avionics Shop Tester
VF	Fighter Squadron
VIDS	Visual Information Display System
VIDS/MAF	Visual Information Display System/Maintenance Action Form
VTS	Versatile Training System
WBS	Work Breakdown Structure
WC	Work Center
WSC	Weapon System Code
X-RAY	Naval Message Reporting System for Aircraft Inventory Changes
YELLOW SHEET	Naval Aircraft Flight Record

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